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Open File Report 89-50

ANTIMONY FLOTATION IN AN SK15 SKIM AIR COARSE FLOTATION MACHINE

by

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ABSTRACT

An Outokumpu SK15 Skim Air Coarse Flotation machine was installed in the Durham Mines concentrator in an effort to reduce slime production and subsequent mineral loss to tails. The cell was inserted into the classification circuit and both primary and secondary cyclones were tested as feed sources for the unit. Various operating parameters were introduced and results compared. Skim Air cell concentrate was tested against conventional flotation concentrate with respect to quantity, quality and mineralogy. A complete circuit survey was conducted with the unit cell on line.

OBJECTIVE

The project objective was to determine the benefits of removing coarse liberated mineral particles from the grinding circuit by applying the principal of coarse or "Flash" flotation. Significant coarse particle recovery would mean an improved overall plant recovery with no detrimental affect on concentrate grade. Other benefits associated with coarse flotation would theoretically be increased throughput and improved concentrate dewatering performance. It was anticipated that a greater quantity of "coarse" in the concentrate would help to decrease product moisture or increase production at the same moisture.

PROJECT DURATION

Equipment installation and initial circuit modifications began on January 14, 1987. Commissioning and run-in was complete by February 13, 1987. Total testing time, including maintenance circuit revisions, was projected to be six months from time of commissioning. The project was divided between Phase I - Primary Circuit Testing and Phase II - Secondary Circuit Testing. Mineralogical reporting and, consequently, data interpretation met with some delay. A final report on the program was therfore delayed to December 1987.

EQUIPMENT DESCRIPTION

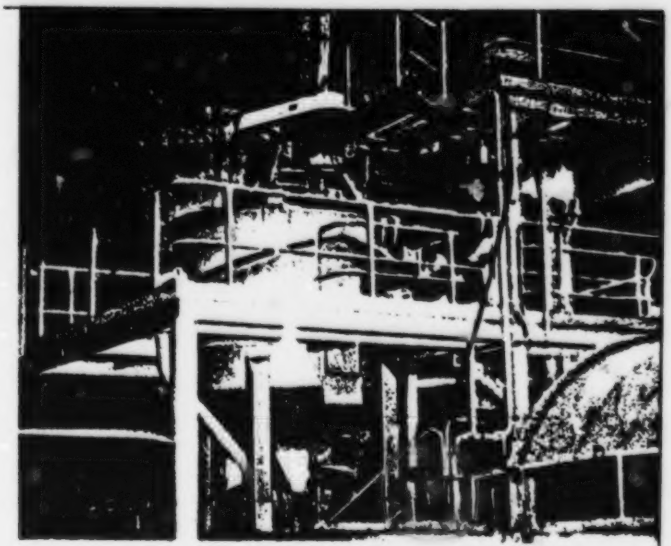
An Outokumpu SK15 Skim Air Coarse Flotation machine was selected as the testing vehicle. The SK15 has a volume of 0.3 m (10 cubic feet or approximately 65 Imperial gallons) and is equipped with the standard O.K. mechanism and automatic cell level control. The cell is fed through a height-adjustable 3" diameter pipe and discharge is via a 2" automatic pinch valve.

Circuit alterations were made to facilitate the use of either primary or secondary cyclone underflow as feed to the SK15.

A typical installation is shown in Figure 1.

OUTOKUMPU
FLASH FLOTATION™ PROCESS

Typical Installation not specific to Durham.



In the Outokumpu Flash Flotation™ method flotation is carried out on the cyclone underflow material before further grinding. The tailings from the Flash Flotation™ go to further grinding by gravity flow.
The concentrate from the Flash Flotation™ is part of the final concentrate.

Hydrocyclones tend to concentrate valuable minerals with high specific gravity into the underflow. This is particularly true with precious metals like gold and silver which hold significant values even when they are by-products.
Recovery of the Flash Flotation™ stage can represent 30 to 60 per cent of the total flotation recovery.

Figure 1: Typical Installation

PHASE I TESTING

Primary cyclone as Feed

The primary ball mill receives 85% of the fresh feed to the grinding circuit. The primary mill discharge is cycloned in a 10" Krebs cyclone with cyclone O/F reporting as rougher flotation feed and cyclone U/F normally entering the secondary circuit at the secondary cyclone feed pump box. For purposes of this phase of testing, the primary cyclone U/F was redirected to feed the SK15 cell. Feed rate was 55 - 60 Imperial gallons per minute at various densities.

SK15 concentrate was routed to first cleaner feed or final concentrate dependent upon grade. Cell tail entered the secondary mill for further grinding.

Discussion Phase I

Phase I testing was restricted to the primary cyclone underflow as cell feed. Feed volume nominally ran from 50 - 56 Imperial gallons/minute with fluctuations due primarily to changes in overall mill feed grade and rate. Parameters tested included feed density, retention time, froth depth and reagent addition. A data summary sheet is included as Table 1.

In general, there was very little differential response to any of the variables other than froth depth. At a froth depth of less than 8", the cell concentrate grade was below 40% Sb while at 8" - 10" of froth, grade improved to between 50% and 60% Sb.

Reagent additions represent a net increase in total reagent consumptions of up to 30% as the main circuit reagent requirements did not decrease during the testing period.

Weekly composites of the cell feed, concentrate and tail along with composites of the flotation concentrate and final tail were collected. These were fractioned into +75, -75 +25, -25 micron sizes and analysed for Sb content and distribution. Data are contained in Table 2(A) - 2(D).

The SK15 cell tail sample was difficult to obtain with assured accuracy therfore actual recovery numbers around the cell are not used. Rather the overall circuit performance is compared with the cell both on line and by-passed. Table 3 is a summary showing feeds and concentrate along with actual plant recovery.

As can be seen from the data, the coarse flotation cell does very little to influence overall plant performance in either concentrate grade or mineral recovery. The reason for this becomes obvious in Table 2(A) - 2(D), Fractional Analysis Data, which clearly illustrates that the SK15 is preferentially floating fine particles just as the conventional flotation circuit is doing. The distribution data are graphically compared in Figure 3.

A major drawback to operating the cell in the primary circuit was a continuous threat of sanding in the cell. This condition was not entirely remedied throughout the testing.

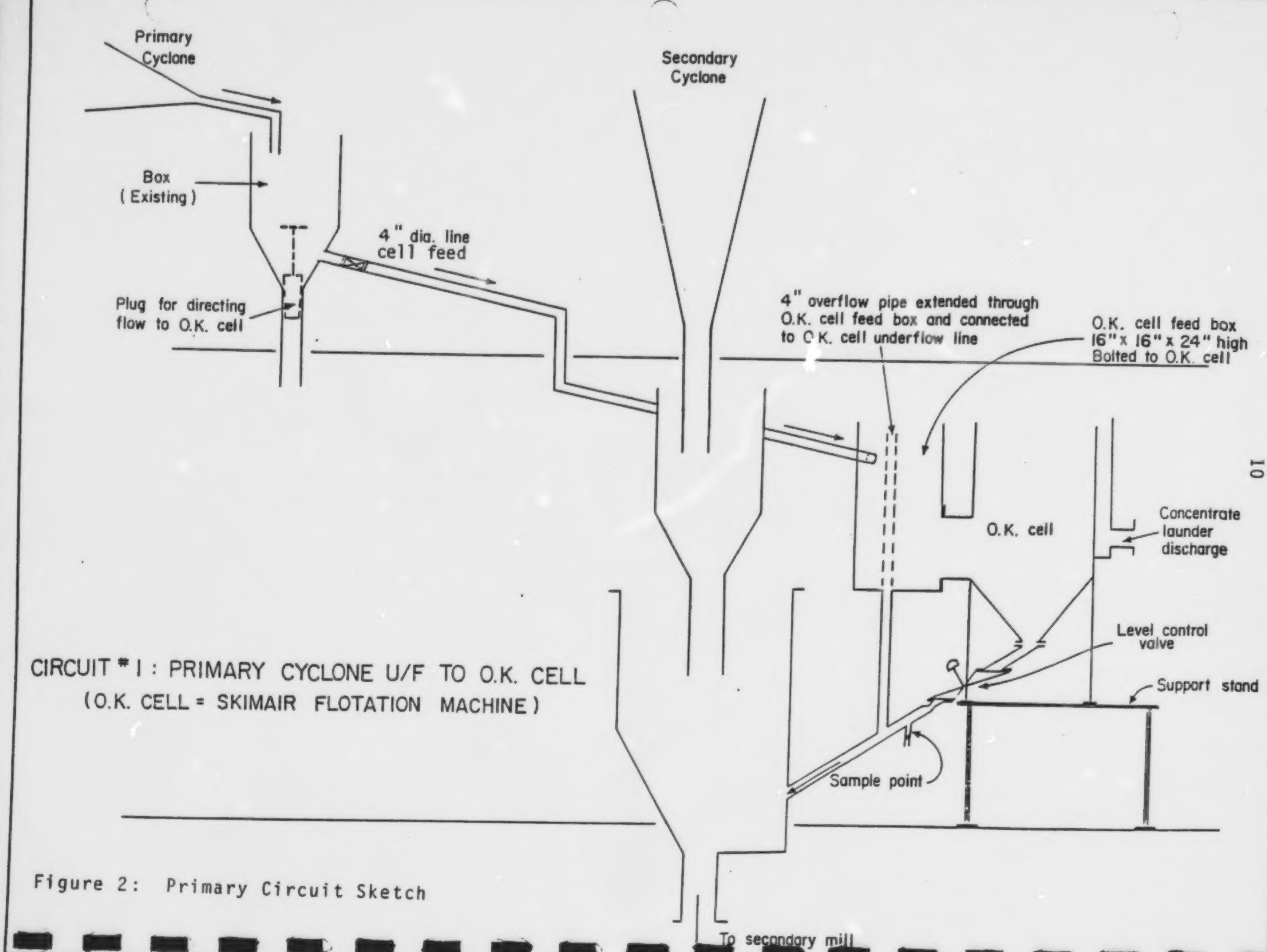

Primary Cyclone
Secondary Cyclone
Box (Existing)
4" dia. line cell feed
Plug for directing flow to O.K. cell
4" overflow pipe extended through O.K. cell feed box and connected to O.K. cell underflow line
O.K. cell feed box 16" x 16" x 24" high Bolted to O.K. cell
O.K. cell
Concentrate launder discharge
Level control valve
Support stand
Sample point
To secondary mill
CIRCUIT # 1 : PRIMARY CYCLONE U/F TO O.K. CELL
(O.K. CELL = SKIMAIR FLOTATION MACHINE)

Figure 2: Primary Circuit Sketch

TABLE 1

OPERATING DATA SUMMARY

FEBRUARY 16 TO MARCH 20, 1987

DATE	FEBRUARY 16 - 20	FEBRUARY 23 - 27	MARCH 2 - 6	MARCH 9 - 13	MARCH 16 - 20
Feed Source	Primary Cyc. U/F	Primary Cyc. U/F	Primary Cyc. U/F	Primary Cyc. U/F	Primary Cyc. U/F
Feed S.T.P.H.	15 - 21 (18)	17	20	19	18
Feed %Solids	58% - 60%	59%	60% - 61%	58%	62%
Reagents Lbs/Ton					
Pb(NO)	0.35	0.22	0.19	0.19	0.17
S-3477	0.02	0.019	0.016	0.008	0.009
MIBC	0.03	0.03	0.026	0.028	0.029
Air 1/s	>250	>250	>250	>250	>250
Froth Depth	2" - 6" Variable	4" - 6"	3"	10"	8"
Cell Water Addition	No	No	No	No	No
Operating Problems	Cell Sanding Poor Froth	Minimal Sanded Once	Cell Sanding Causing interruptions Operations	Excessive Sanding Problems	Sanding Problems

TABLE 2(A): FRACTIONAL ANALYSIS DATA
FEBRUARY 16 - 20, 1987

Cell Feed from Primary Cyclone

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air Cell Feed	+75	36.6 g	2.67%	0.977	57.37%
	-75 +25	8.6 g	5.41%	0.465	27.30%
	-25	4.6 g	5.68%	9.261	15.33%
Skim Air Cell Conc.	+75	5.5 g	31.7%	1.74	9.6%
	-75 +25	18.1 g	39.5%	7.15	39.3%
	-25	35.4 g	26.3%	9.31	51.2%
Skim Air Cell Tail	+75	38.9 g	24.3%	0.945	52.47%
	-75 +25	6.9 g	4.54%	0.313	17.38%
	-25	12.6 g	4.31%	0.543	30.15%
Head (Calc)					
Flotation Concentrate	+75	10.0 g	61.1%	6.11	16.19%
	-75 +25	17.1 g	66.9%	11.44	30.31%
	-25	31.5 g	64.1%	20.19	53.50%
Final Flot. Tail	+75	26.8 g	0.23%	0.062	25.30%
	-75 +25	12.1 g	0.33%	0.040	16.33%
	-25	18.8 g	0.76%	0.143	58.37%

TABLE 2(B): FRACTIONAL ANALYSIS DATA
FEBRUARY 23 - 27, 1987

Cell Feed from Primary Cyclone

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air	+75	35.2 g	2.66%	0.936	41.09%
Cell Feed	-75 +25	7.9%	6.47%	0.511	22.43%
	-25	14.3 g	5.81%	0.831	36.48%
Skim Air	+75	6.6 g	4.92%	0.325	2.01%
Cell Conc.	-75 +25	20.3 g	27.50%	5.583	34.55%
	-25	35.6 g	28.80%	10.253	63.44%
Skim Air	+75	47.3 g	2.19%	1.036	43.75%
Cell Tail	-75 +25	8.7 g	6.16%	0.536	22.64%
	-25	15.7 g	5.07%	0.796	33.61%
Head (Calc)					
Flotation	+75	13.5 g	60.4%	8.154	21.52%
Concentrate	-75 +25	17.6 g	64.1%	11.282	29.78%
	-25	28.3 g	65.2%	18.452	48.70%
Final Flot.	+75	27.9 g	0.26%	0.073	25.98%
Tail	-75 +25	11.8 g	0.37%	0.044	15.66%
	-25	21.6 g	0.76%	0.164	58.36%

TABLE 2(C): FRACTIONAL ANALYSIS DATA
MARCH 2 - 6, 1987

Cell Feed from Primary Cyclone

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air Cell Feed	+75	41.7 g	1.09%	0.457	32.62%
	-75 +25	8.1 g	4.16%	0.337	24.05%
	+25	13.4 g	4.53%	0.607	43.33%
Skim Air Cell Conc.	+75	6.9 g	1.54%	0.106	0.84%
	-75 +25	10.2 g	13.30%	1.357	10.74%
	-25	42.3 g	26.40%	11.167	88.42%
Skim Air Cell Tail	+75	42.6 g	1.54%	0.656	50.38%
	-75 +25	5.7 g	4.81%	0.274	21.04%
	-25	10.3 g	3.61%	0.372	28.57%
Head (Calc)					
Flotation Concentrate	+75	11.9 g	57.7%	6.890	18.26%
	-75 +25	16.5 g	66.0%	10.890	28.85%
	-25	30.9 g	64.6%	19.961	52.89%
Final Flot. Tail	+75	30.0 g	0.27%	0.081	34.32%
	-75 +25	11.2 g	0.34%	0.038	16.10%
	-25	16.3 g	0.72%	0.117	49.58%

TABLE 2(D): FRACTIONAL ANALYSIS DATA
MARCH 9 - 13, 1987

Cell Feed from Primary Cyclone

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air	+75	41.4 g	1.44%	0.596	36.68%
Cell Feed	-75 +25	7.4 g	7.05%	0.522	32.12%
	-25	8.9 g	5.70%	0.507	31.20%
Skim Air	+75	3.50 g	2.36%	0.083	0.26%
Cell Conc.	-75 +25	8.90 g	50.90%	4.530	14.29%
	-25	46.30 g	58.50%	27.086	85.45%
Skim Air	+75	43.6 g	2.21%	0.964	55.63%
Cell Tail	-75 +25	6.0 g	7.14%	0.428	24.70%
	-25	7.8 g	4.37%	0.341	19.68%
Head (Calc)					
Flotation	+75	13.7 g	62.7%	8.590	22.97%
Concentrate	-75 +25	18.9 g	67.5%	12.758	34.11%
	-25	25.6 g	62.7%	16.051	42.92%
Final Flot.	+75	28.2 g	0.23%	0.065	29.55%
Tail	-75 +25	10.5 g	0.31%	0.033	15.00%
	-25	19.3 g	0.63%	0.122	55.45%

TABLE 3: ASSAY COMPARISON FEED FROM PRIMARY CYCLONE

Date	Flotation Feed	Skim Air Feed %Sb	Flotation Concentrate %Sb	Skim Air Concentrate	Plant Recovery
Feb. 5	4.33%	-----	65.4%	39.9%	91.2%
6	4.64%	-----	63.6%	26.7%	92.0%
9	4.20%	4.52%	59.5%	30.7%	91.1%
10	4.38%	5.57%	61.9%	44.0%	90.7%
17	3.24%	3.18%	65.1%	30.9%	90.2%
18	3.35%	3.35%	66.4%	28.5%	88.3%
19	2.85%	2.85%	65.2%	29.0%	86.2%
23	4.14%	4.04%	64.9%	22.2%	89.8%
24	3.50%	3.52%	63.8%	25.1%	89.5%
25	3.16%	3.42%	65.0%	21.2%	87.3%
26	4.43%	5.11%	63.9%	34.2%	89.8%
27	4.31%	3.62%	64.3%	33.2%	90.7%
March 2	2.74%	3.27%	63.4%	12.9%	87.4%
3	2.62%	2.81%	61.4%	40.7%	86.3%
5	2.70%	2.80%	63.7%	24.5%	85.7%
9	3.27%	3.32%	66.1%	45.2%	87.6%
10	2.87%	2.81%	65.3%	53.5%	88.2%
11	3.12%	3.28%	64.3%	53.0%	88.1%
12	3.74%	3.51%	64.5%	44.5%	90.0%
13	3.66%	3.80%	64.8%	60.1%	91.1%
16	3.59%	3.29%	64.2%	55.0%	90.2%
17	3.49%	3.42%	63.4%	-----	90.0%
18	2.94%	3.22%	63.8%	46.6%	88.5%
19	3.20%	3.63%	63.6%	52.8%	90.8%
20	3.70%	3.76%	63.6%	24.5%	89.5%
23	3.32%	Down	65.4%	Down	88.6%
24	3.17%	Down	65.7%	Down	88.4%
25	3.47%	Down	64.6%	Down	88.7%
26	3.91%	Down	64.2%	Down	90.0%
27	3.65%	Down	63.6%	Down	88.9%
30	3.93%	Down	67.1%	Down	90.0%

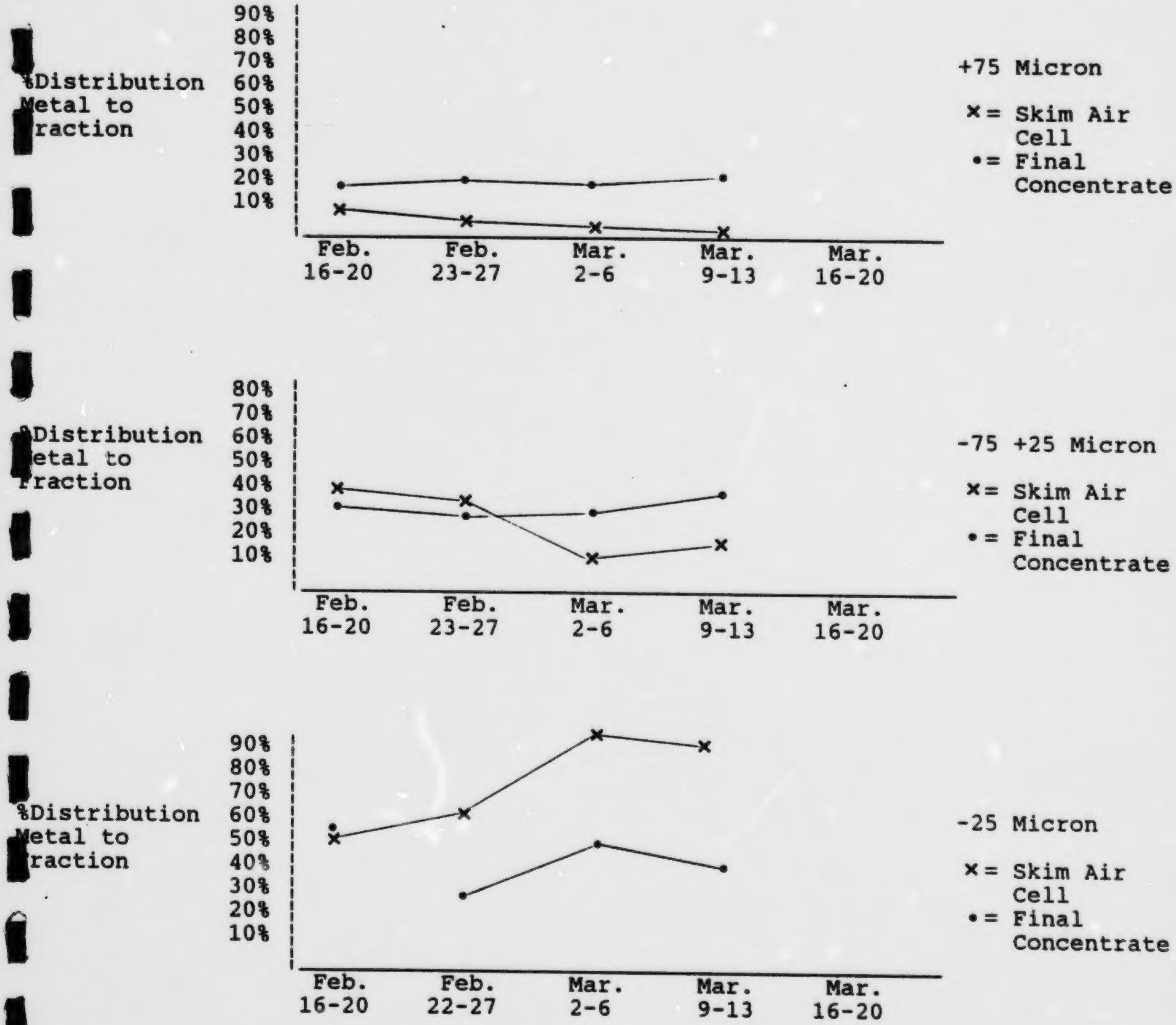


FIGURE 3: SKIM AIR CONCENTRATE COMPARED BY FRACTION TO FINAL CONCENTRATE - PRIMARY CYCLONE AS FEED

PHASE II TESTING

Secondary Cyclone as Feed

Fifteen percent of the total fresh feed to the grinding circuit is fed directly into the secondary mill. This supplements the main feed input from the primary cyclone underflow. The secondary mill operates in closed circuit with a 15" Krebs cyclone. Cyclone overflow supplies the bulk of the rougher flotation feed.

Since the secondary circuit normally operates with around a 300% circulating load, the total volume was too great for the SK15 to handle. The cyclone underflow was subsequently split with a portion reporting to the SK15 cell and the remainder continuing on in the mill circulating load loop. Since the cell tail rejoined the cyclone underflow in the mill it was felt that this "portioning off" would not significantly affect the test work.

SK15 concentrate routing remained the same for this phase of testing as for the primary.

Reagent additions were made at the cell feed and into the cell froth crowder during all tests. Only those agents normally used in the main flotation circuit were used in the test work.

Discussion

Phase II testing was performed using the secondary cyclone underflow as the feed source for the SK15 cell. Due to the large volume flow at this point of the circuit, the cyclone underflow was split to provide a manageable quantity of feed to the cell. As with Phase I testing, variables were introduced to influence circuit performance with different cell conditions.

Initally, cell sanding was continuous due to high % solid feed. Also, it was not possible to build and maintain a froth bed at 66 - 68% solids. Concentrate produced from the "coarse" flotation during the first two weeks of testing paralleled that of Phase I testing in both assay and size distribution. Size fractions analysed during this phase were +149, -149 +75, -75 +37, -37 microns.

On June 3 a small amount of process water was added to the cell feed with rather dramatic results. Froth conditions improved to the point that a consistent clean, well formed and manageable froth could be maintained. At times a finished concentrate was produced. This is illustrated in Table 5, Assay Comparison.

Of even greater significance however, was the change in the metal distribution between the fractions in the coarse concentrate. Following water addition to the feed, more than 50% of the total metal reporting was in the +37 micron fraction and the +75 micron fraction assayed up to 66% Sb. Mineralogy comparing final concentrate to coarse cell concentrate shows the % distribution of stibnite to be similar in both cases.

Total plant recovery remained largely unaffected by the performance of the SK15 cell. This was not completey unexpected and could be due in large part to the fact that only a portion of the total feed passed through the unit. Similarily, final concentrate grades did not show differences with the SK15 on line or bypassed.

Products are compared in fraction in Table 6(A) to 6(F) for % assay and metal distribution. Concentrate comparisons are illustrated graphically in Figure 5.

Figures 6 and 7 compare % Sb assay and % metal distribution between the two circuits tested. Superior performance was obtained using the secondary cyclone as a feed source when compared with the primary cyclone. Also the secondary operation shows much greater stability than that of the primary.

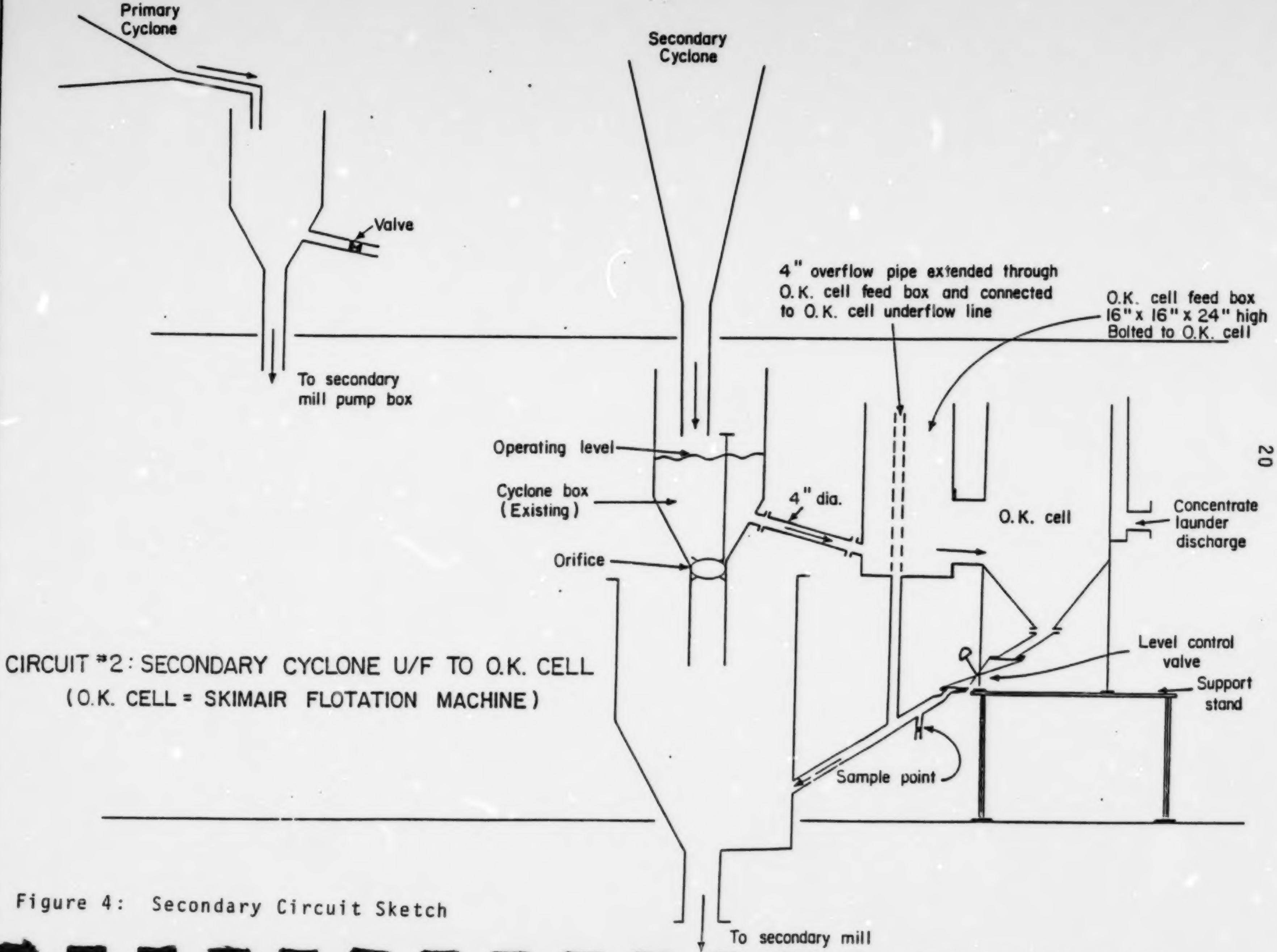

Primary Cyclone
Valve
To secondary mill pump box
Secondary Cyclone
4" overflow pipe extended through O.K. cell feed box and connected to O.K. cell underflow line
O.K. cell feed box 16" x 16" x 24" high Bolted to O.K. cell
Operating level
Cyclone box (Existing)
4" dia.
O.K. cell
Concentrate launder discharge
Orifice
Level control valve
Support stand
Sample point
To secondary mill
CIRCUIT #2: SECONDARY CYCLONE U/F TO O.K. CELL
(O.K. CELL = SKIMAIR FLOTATION MACHINE)

Figure 4: Secondary Circuit Sketch

TABLE 4

OPERATING DATA SUMMARY

MAY 18 - AUGUST 21, 1987

DATE	MAY 18 - 22	MAY 25 - 29	JUNE 1 - 5	JUNE 8 - 12	JUNE 15 - 19
eed Source	Sec. Cyc. U/F	Sec. Cyc. U/F	Sec. Cyc. U/F	Sec. Cyc. U/F	Sec. Cyc. U/F
Feed S.T.P.H.					
eed %Solids	68%	66%	66 - 68%	67%	70%
eagents b/Ton					
Pb(NO)	0.19	0.22	0.14	0.25	0.28
S 3477	0.004				
[illegible]	0.005	0.005	0.002	0.003	0.003
[illegible]	0.03	0.03	0.04	0.04	0.04
ir 1/S	Full	Full	Full	Full	Full
roth Depth	2"	2 - 4"	6"	6"	6"
ll Water ddition	No	No	8 gpm	8 gpm	8 gpm
erating Problems	No Flotation. Density too High, poor froth formation	Poor Froth	Good Flotation after water addition. June 3, 55% Sb Concentrate	As last week	Fluctuations in feed grade causing discontinuity in froth generation. Some sanding

TABLE 5: ASSAY COMPARISON - FEED FROM SECONDARY CYCLONE

Date		Flotation Feed	Skim Air Feed %Sb	Flotation Concentrate %Sb	Skim Air Concentrate	Plant Recovery
April	1	3.26%	4.81%	65.8%	38.6%	88.2%
	2	2.78%	2.04%	67.1%	43.0%	86.7%
	3	4.41%	4.21%	66.3%	62.2%	90.7%
	7		4.54%	65.5%	60.8%	90.1%
	8		4.55%	65.9%	42.1%	88.5%
	22	3.78%	-----	63.1%	52.3%	87.2%
	23	3.42%	3.56%	62.9%	51.9%	87.1%
	29	2.64%	2.73%	64.0%	16.0%	86.0%
	30	2.82%	Down	64.2%	Down	82.0%
May	19	2.99%	3.20%	64.4%	50.0%	84.1%
	20	3.62%	4.95%	66.2%	54.4%	87.7%
	21	3.94%	4.29%	65.7%	40.3%	87.5%
	22	3.93%	4.48%	63.2%	-----	87.9%
	25	4.19%	4.73%	65.1%	46.6%	86.0%
	26	3.55%	3.98%	65.8%	-----	85.7%
	27	2.78%	3.94%	63.5%	49.2%	85.5%
	28	3.30%	3.52%	64.6%	48.2%	86.6%
	29	3.14%	Down	64.6%	Down	85.5%
June	1	3.47%	3.47%	64.4%	6.91%	86.7%
	2	2.87%	2.70%	64.4%	21.3%	84.2%
	3	2.69%	3.05%	64.8%	54.1%	80.4%
	4	2.32%	3.55%	64.7%	54.6%	81.7%
	5	2.73%	2.45%	65.4%	36.1%	84.2%
	8	2.52%	2.39%	64.7%	47.0%	85.1%
	9	4.05%	4.72%	62.5%	58.5%	88.7%
	10	3.47%	3.61%	64.8%	49.7%	87.8%
	11	3.00%	3.28%	65.7%	58.0%	86.8%
	12	3.20%	3.32%	64.7%	60.0%	86.6%
	13	3.07%	3.05%	65.0%	56.9%	86.4%
	15	2.89%	3.17%	64.0%	51.0%	87.4%
	16	2.68%	3.39%	65.3%	54.9%	83.9%
	17	3.25%	3.78%	64.9%	54.0%	87.4%
	18	4.35%	5.48%	64.6%	60.8%	87.7%
	19	4.22%	5.65%	64.9%	62.5%	87.0%
	22	6.01%	5.56%	64.7%	59.7%	91.0%
	23	4.84%	4.66%	64.3%	59.1%	88.8%
	24	3.59%	4.20%	63.9%	51.7%	85.7%
	25	3.89%	4.29%	64.0%	58.7%	86.5%
	26	4.29%	4.37%	62.7%	58.4%	86.5%
	30	4.32%	Down	63.6%	Down	88.1%

TABLE 5 (Continued)

Date	Flotation Feed	Skim Air Feed %Sb	Flotation Concentrate %Sb	Skim Air Concentrate	Plant Recovery
July 1	3.85%	Down	63.4%	Down	87.6%
2	5.16%	Down	63.6%	Down	88.5%
3	3.20%	Down	63.6%	Down	88.5%
6	3.92%	Down	63.6%	Down	86.9%
7	4.55%	Down	62.0%	Down	89.1%
8	3.79%	Down	61.3%	Down	87.5%
9	3.67%	Down	63.9%	Down	86.4%
10	4.00%	Down	65.2%	Down	86.1%

TABLE 6(A): FRACTIONAL ANALYSIS DATA
MAY 19 - 22, 1987

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air Cell Feed	+145	70.7 g	0.69%	0.49	20.8%
	+149 +75	12.1 g	7.54%	0.88	37.3%
	-75 +37	5.6 g	7.26%	0.41	17.4%
	-25	11.5 g	3.05%	0.58	24.6%
Skim Air Cell Conc.	+149	13.4 g	12.4%	1.66	3.60%
	-149 +75	55.6 g	50.4%	28.02	60.83%
	-75 +37	9.9 g	59.2%	5.86	12.72%
	-37	20.2 g	52.1%	10.52	22.84%
Skim Air Cell Tail	+149	73.8 g	1.14%	0.84	34.0%
	-149 +75	13.6 g	7.64%	1.04	42.1%
	-75 +37	7.2 g	5.28%	0.38	15.4%
	-37	5.1 g	4.20%	0.21%	8.5%
Head (Calc)					
Flotation Feed	+149	N/A	N/A	N/A	N/A
	-149 +75				
	-75 +37				
	-37				
Final Flot. Feed	+149	N/A	N/A	N/A	N/A
	-149 +75				
	-75 +37				
	-37				

TABLE 6(B): FRACTIONAL ANALYSIS DATA
MAY 25 - 29, 1987

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air	+149	65.2 g	1.86%	1.21	36.3%
	-149 +75	13.9 g	6.96%	0.97	29.1%
	-75 +37	7.1 g	7.09%	0.50	15.0%
	-37	13.1 g	4.95%	0.65	19.5%
Skim Air Cell Conc.	+149	2.6 g	4.83%	0.126	0.52%
	-149 +75	15.1 g	49.8%	7.520	31,25%
	-75 +37	4.4 g	58.5%	2.570	10.68%
	-37	27.1 g	51.1%	13.848	57.55%
Skim Air Cell Tail	+149	67.8 g	1.86%	1.26	42.0%
	-149 +75	13.2 g	6.29%	0.83	27.7%
	-75 +37	6.2 g	6.34%	0.39	13.0%
	-37	12.0 g	4.35%	0.52	17.3%
Head(Calc)					
Flotation Feed	+149	17.0 g	0.59%	0.10	3.6%
	-149 +75	27.3 g	1.75%	0.48	17.4%
	-75 +37	16.4 g	3.53%	0.58	21.0%
	-37	38.6 g	4.14%	1.60	58.0%
Final Flot. Tail	+149	20.0 g	0.36%	0.07	12.5%
	-149 +75	31.0 g	0.46%	0.14	25.0%
	-75 +37	16.3 g	0.59%	0.10	17.9%
	-37	31.8 g	0.78%	0.25	44.6%

TABLE 6(C): FRACTIONAL ANALYSIS DATA
JUNE 1 - 5, 1987

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air Cell Feed	+149	71.8 g	0.35%	0.25	14.9%
	-149 +75	11.1 g	6.04%	0.67	40.1%
	-75 +37	5.4 g	5.72%	0.31	18.6%
	-37	11.7 g	3.77%	0.44	26.3%
Skim Air Cell Conc.	+149	28.2 g	6.11%	1.72	4.50%
	-149 +75	54.2 g	50.4%	27.32	71.46%
	-75 +37	10.2 g	54.1%	5.52	14.44%
	-37	6.5 g	56.6%	3.67	9.60%
Skim Air Cell Tail	+149	74.6 g	0.63%	0.47	28.1%
	-149 +75	10.4 g	5.90%	0.61	36.5%
	-75 +37	5.8 g	5.40%	0.31	18.6%
	-37	9.2 g	3.10%	0.28	16.8%
Head (Calc)					
Flotation Feed	+149	20.5 g	0.83%	0.17	5.9%
	-149 +75	28.7 g	1.95%	0.56	19.6%
	-75 -37	16.6 g	4.23%	0.70	24.5%
	-37	33.6 g	4.25%	1.43	50.0%
Final Flot. Tail	+149	24.6 g	0.35%	0.09	16.4%
	-149 +75	29.7 g	0.49%	0.15	27.3%
	-75 +37	16.2 g	0.63%	0.10	18.2%
	-37	29.3 g	0.72%	0.21	38.2%

TABLE 6(D): FRACTIONAL ANALYSIS DATA
JUNE 8 - 12, 1987

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air Cell Feed	+149	64.5 g	1.47%	0.95	36.7%
	-149 +75	12.4 g	5.94%	0.74	28.6%
	-75 +37	7.6 g	5.59%	0.42	16.2%
	-37	15.1 g	3.19%	0.48	18.5%
Skim Air Cell Conc.	+149	38.9 g	46.4%	18.05	34.0%
	-149 +75	43.1 g	58.1%	25.04	47.2%
	-75 +37	5.3 g	63.4%	3.36	6.33%
	-37	11.1 g	59.6%	6.62	12.47%
Skim Air Cell Tail	+149	72.6 g	1.29%	0.94	38.5%
	-149 +75	11.0 g	6.98%	0.77	31.6%
	-75 +37	5.0 g	6.02%	0.30	12.3%
	-37	10.5 g	4.09%	0.43	17.6%
Head (Calc)					
Flotation Feed	+149	21.0 g	0.91%	0.21	7.69%
	-149 +75	29.3 g	1.96%	0.57	20.88%
	-75 +37	17.1 g	3.74%	0.64	23.44%
	-37	30.0 g	4.37%	1.31	47.98%
Final Flot. Tail	+149	23.3 g	0.27%	0.06	12.5%
	-149 +75	39.6 g	0.44%	0.13	23.08%
	-75 +37	15.9 g	0.58%	0.09	18.75%
	-37	30.2 g	0.68%	0.20	41.67%

TABLE 6(E): FRACTIONAL ANALYSIS DATA
JUNE 15 - 19, 1987

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air Cell Feed	+149	71.2 g	0.86%	0.61	27.6%
	-149 +75	11.5 g	6.51%	0.75	33.9%
	-75 +37	5.7 g	6.29%	0.36	16.3%
	-37	11.1 g	4.47%	0.49	22.2%
Skim Air Cell Conc.	+149	2.5 g	30.70%	0.77	1.7%
	-149 +75	37.8 g	61.90%	23.40	39.80%
	-75 +37	6.9 g	65.70%	4.53	7.71%
	-37	51.7 g	58.20%	30.09	51.18%
Skim Air Cell Tail	+149	72.6 g	0.51%	0.37	17.7%
	-149 +75	13.0 g	6.71%	0.87	41.6%
	-37	9.1 g	5.11%	0.46	22.0%
Head (Calc)					
Flotation Feed	+149	21.3 g	1.02%	0.22	6.43%
	-149 +75	31.7 g	2.67%	0.85	24.85%
	-75 +37	14.9 g	4.97%	0.74	21.64%
	-37	31.6 g	5.09%	1.61	47.08%
Final Flot. Tail	+149	20.8 g	0.27%	0.06	11.76%
	-149 +75	30.5 g	0.36%	0.11	21.57%
	-75 +37	17.0 g	0.53%	0.09	17.60%
	-37	31.5 g	0.79	0.25	49.01%

TABLE 6(F): FRACTIONAL ANALYSIS DATA
JUNE 22 - 26, 1987

Product	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air Ceel Feed	+149	62.2 g	0.96%	0.59%	20.2%
	-149 +75	18.2 g	6.31%	1.15	39.38%
	-75 +37	6.6 g	8.56%	0.56	19.17%
	-37	12.2 g	5.05%	0.62	21.20%
Skim Air Cell Conc.	+149	4.0 g	43.3%	1.73	3.06%
	-149 +75	28.7 g	66.8%	19.17	33.88%
	-75 +37	14.9 g	63.9%	9.52	16.83%
	-37	51.7 g	50.6%	26.16	46.24%
Skim Air Cell Tail	+149	57.1 g	2.05%	1.17	32.4%
	-149 +75	18.2 g	6.23%	1.13	31.7%
	-75 +37	9.2 g	7.40%	0.68	18.8%
	-37	15.3 g	4.15%	0.63	17.4%
Head (Calc)					
Flotation Feed	+149	11.9 g	1.15%	0.14	3.32%
	-149 +75	33.6 g	2.90%	0.97	22.98%
	-75 +37	25.9 g	5.62%	1.45	34.36%
	-37	28.9 g	5.80%	1.66	39.34%
Final Flot. Tail	+149	13.3 g	0.31%	0.04	6.89%
	-149 +75	40.0 g	0.50%	0.20	34.48%
	-75 +37	16.6 g	0.59%	0.09	15.42%
	-37	30.1 g	0.84%	0.25	43.10%

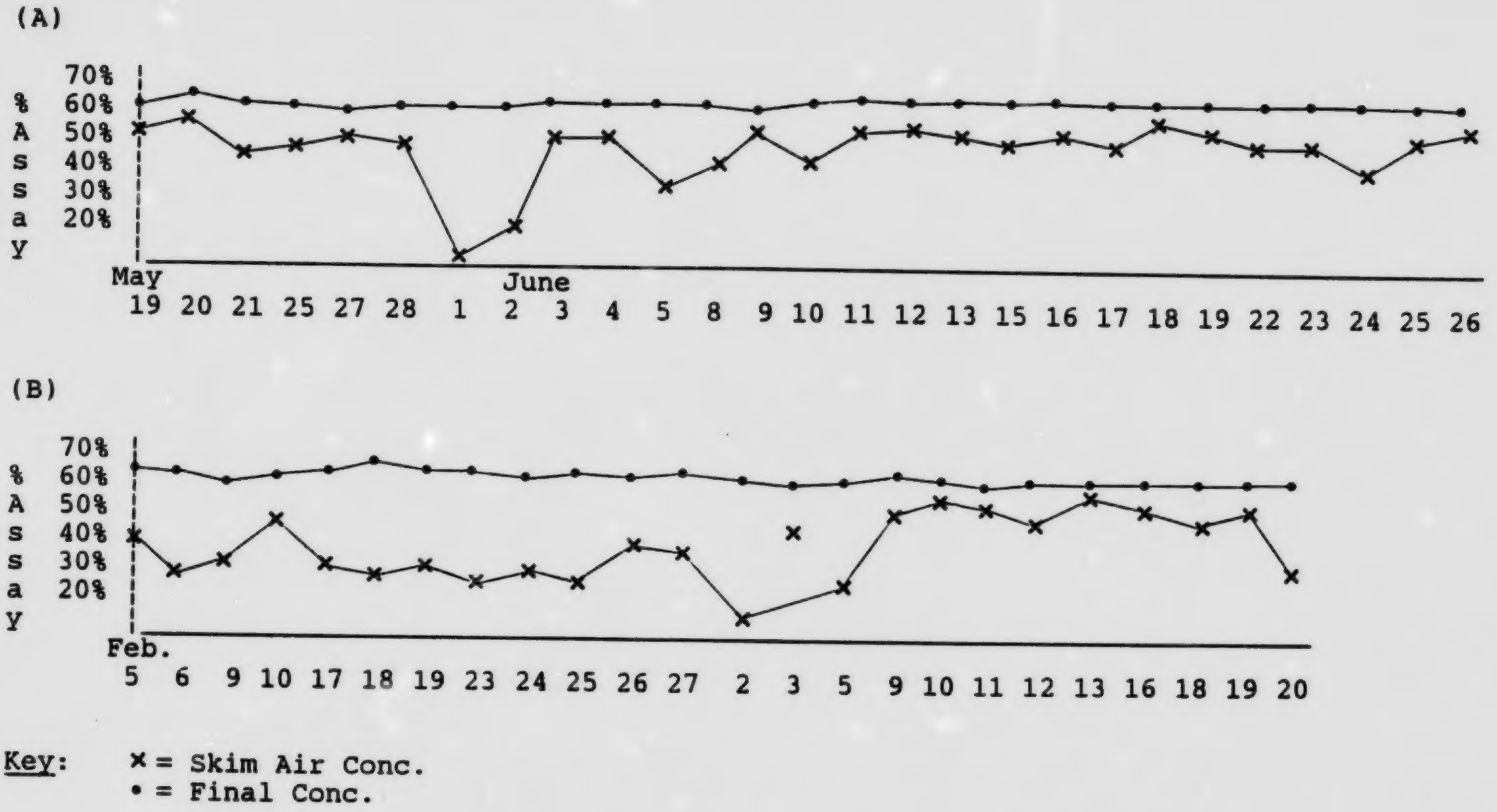


FIGURE 5: ASSAY COMPARISON SKIM AIR CONCENTRATE TO FINAL CONCENTRATE WITH (A) SECONDARY CYCLONE AS FEED
(B) PRIMARY CYCLONE AS FEED

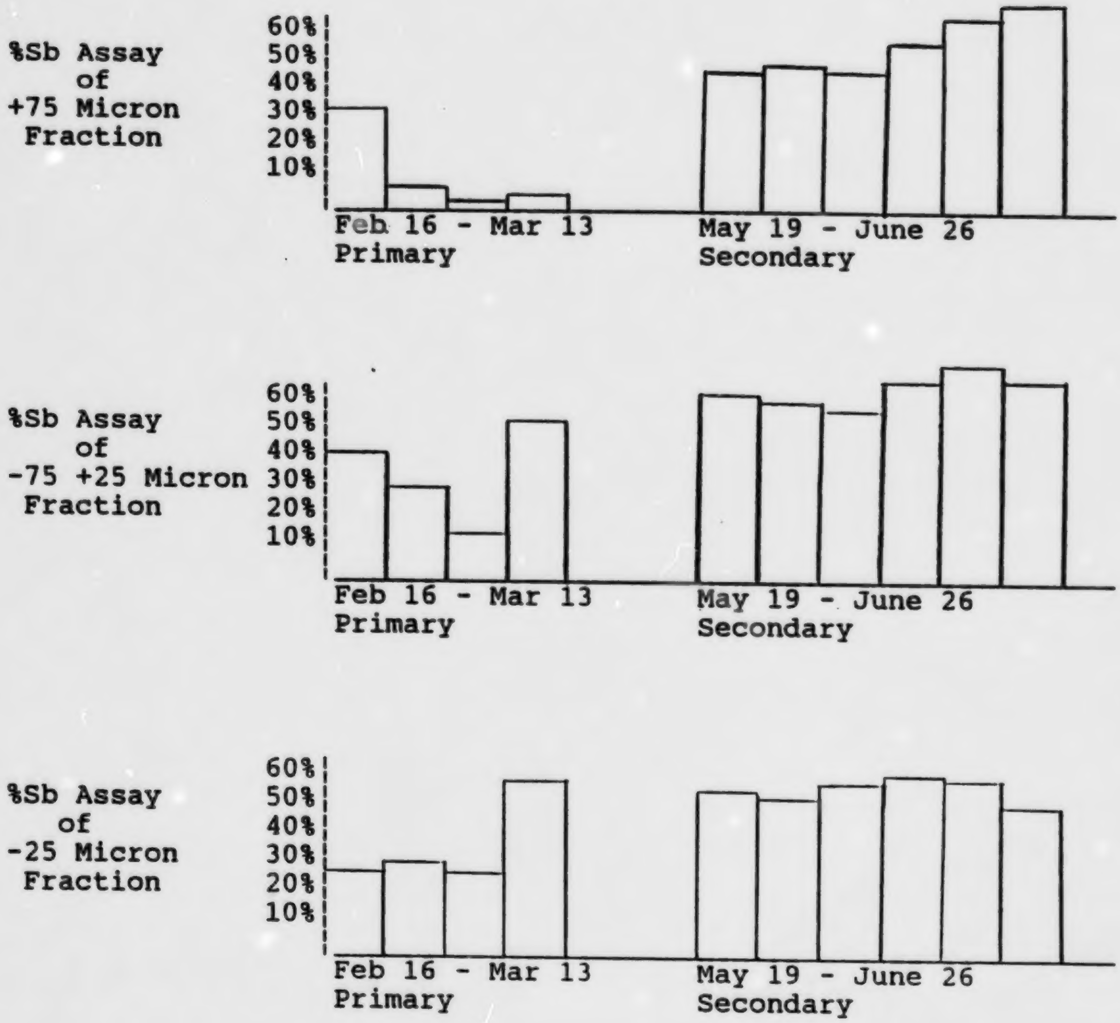


FIGURE 6: %SB ASSAY COMPARISON

SKIM AIR CONCENTRATE BY FRACTION
VS
(A) PRIMARY CYCLONE AS FEED
(B) SECONDARY CYCLONE AS FEED

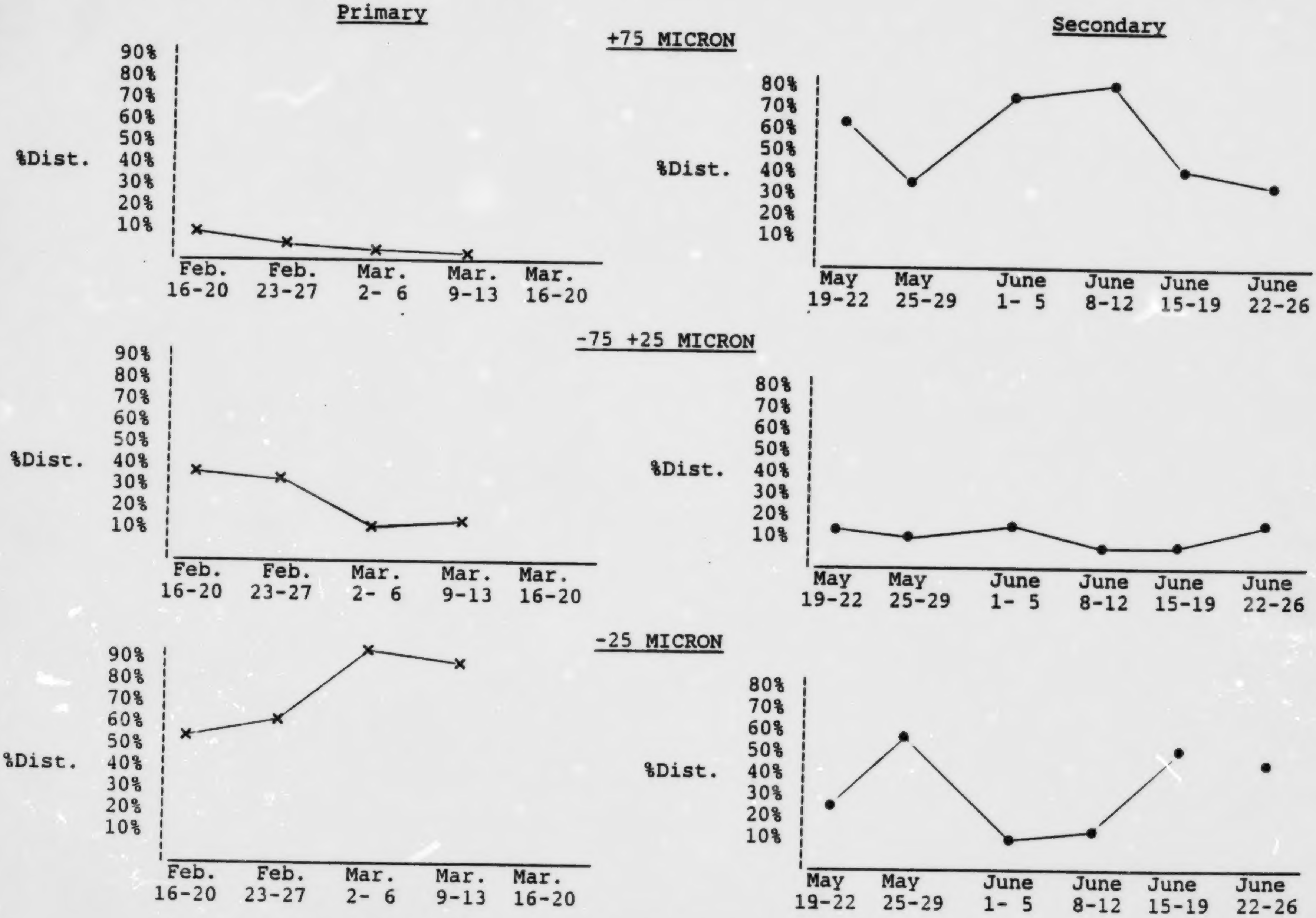


FIGURE 7: METAL %DISTRIBUTION IN SKIM AIR CONCENTRATE C[illegible]ARI[illegible]TW[illegible]IFF[illegible]NT[illegible]D[illegible]RCE[illegible]

MINERALOGY

Investigations of stream products both fractioned and full were performed using an electron microprobe at Research and Productivity Council, N.B. Reports from R.P.C. are included in Appendix A.01 - A.05.

All Results indicate excellent recovery in the mid 90% range for liberated antimony sulphides. Tail losses, the majority of which occur in the -25 micron fraction, are attributable to poor liberation of the desired mineral. Of major importance was the discovery that mineralization down to just a few microns in size appeared as particles locked with gangue. A second major significant find was the abundant occurence of an iron-stibnite sulphide called Berthierite (56% SB, 12% Fe). Berthierite was identified in concentrate when locked with either native antimony or stibnite but reported to tails when locked with gangue.

CONCLUSIONS

For the Durham concentrate, introducing "coarse" or "flash" flotation into the primary grinding circuit has little or no effect on overall plant performance. There are however, encouraging possibilities presented when the secondary grinding circuit is subjected to coarse flotation of the cyclone underflow. Size analysis and metal assay of the concentrate produced indicates that coarse, liberated antimony sulphide (+75 micron) responds to rapid flotation in a coarse flotation unit.

The size of the unit used at Durham limited the scope of the project to a portion of the secondary mill circulating load. It is feasible that, with an appropriately sized unit, a major amount of the recoverable antimony could be taken from so-called "coarse" flotation. This would not completely alleviate recovery problems which occur from time to time at Durham, however.

As illustrated by the mineralogical reports, recovery loss is more a function of fine, non-liberated or only partially liberated minerals than it is a function of liberated fine or "slimes".

Further investigative work is required to determine the economics of trying to recover the metal lost due to poor liberation in these fine fractions.

As part of the objective of this project was to improve the performance of the concentrate dewatering circuit, it is appropiate to mention that, although the dewatering circuit is continuously monitored for moisture control, at no time during the test work was there any indication of improved operation which could be directly attributed to the SK15. In all fairness, the quantity of concentrate produced by the SK15 was not sufficient to have had a significant impact on filter/dryer product quality.

6.0 CIRCUIT SURVEY

At the conclusion of the testing for coarse flotation recovery, a circuit survey was conducted to try and determine the mineral distribution throughout grinding and flotation and to attempt to understand the significance of the Skim Air Cell to that distribution.

Twenty five samples were collected, fractioned to +75, -75 +25, -25 micron and assayed by fraction. Head assays for each sample point were also acquired. Results were given to the Process Studies Group at Mineral Resources Branch of the Department of Natural Resources for computation using a computerized mass balance program called MatBal. The Group's report is enclosed in Appendix B. Unfortunately, fractional assays were not obtained for mill feed samples so these could not be untilized in the MatBal program. As a result, only head sample assays were used and only 18 of the 25 streams sampled were included in determining a mass balance.

This had the unfortunate tendancy to mask mass flows as indicated by the high recovery number attributed to the SK15. To say that 45% of total concentrate tonnage was produced by the SK15 is a significant overstatement. This becomes obvious when you consider that only about 1/3 of total fresh feed was being routed through the cell. Also of importance to note was that there was no apparent significant metal loss due to SK15 flotation as reflected by the assays of the main flotation circuit.

Figures 7(A) to 7(F) compare similar streams thoughout the circuit. That is to say, those streams which represent concentrate are compared to one another, those that represent tails are compared, etc. Only streams used in figures 7(E) and 7(F) are open to extreme interpretation. There is no mistaking the similarity in metal deportment in the remaining compared streams.

It is possible that alternate scenarios using different modes within the MatBal computer program may provide more acceptable results.

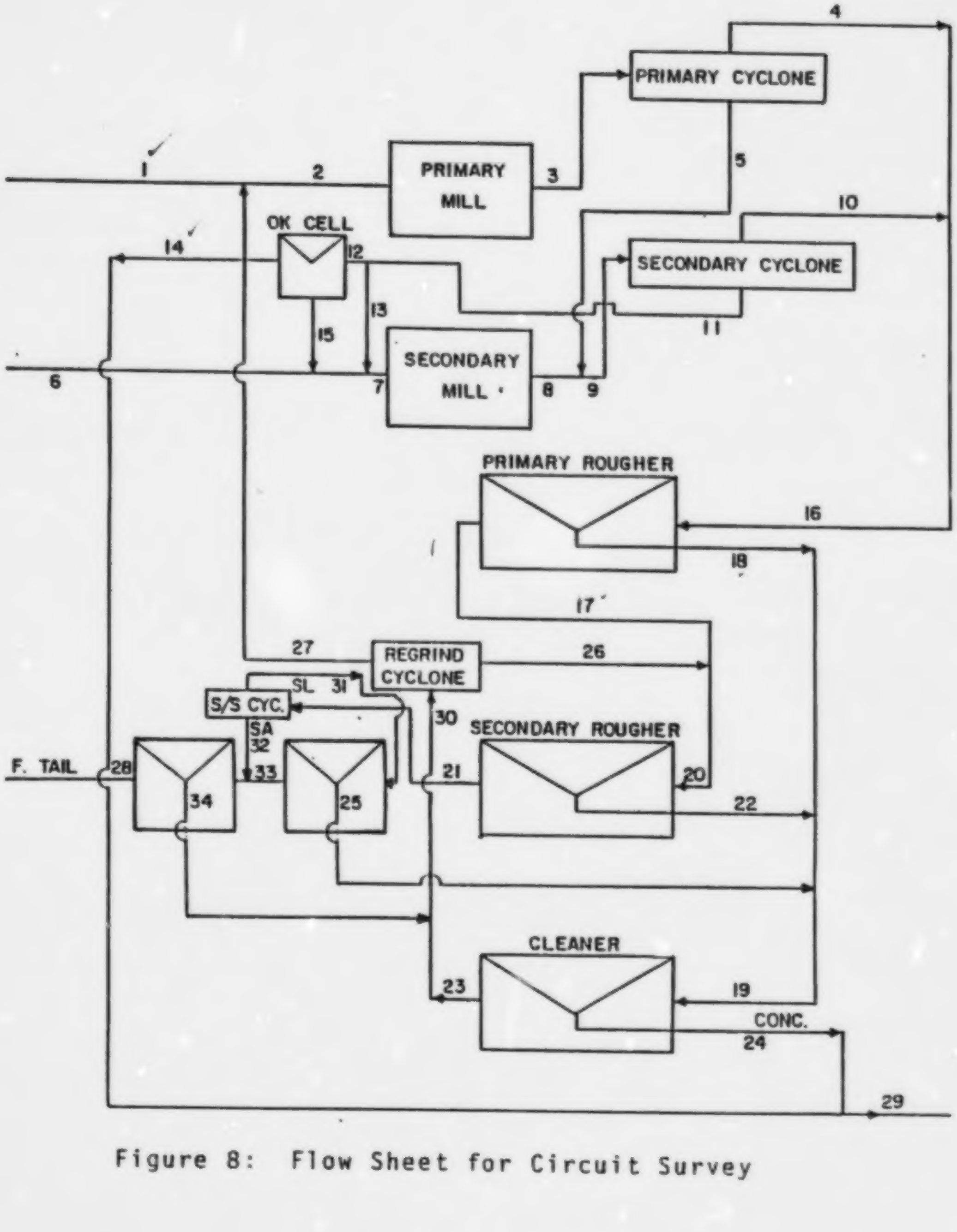


Figure 8: Flow Sheet for Circuit Survey

TABLE 7(A): FRACTIONAL ANALYSIS DATA
JUNE 23, 1987

Circuit Survey

Product (Number)	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
P. Mill Discharge (3)	+75	44.8 g	2.95%	1.32	37.0%
	-75 +25	14.0 g	6.73	0.94	26.3%
	-25	19.9 g	6.56%	1.31	36.7%
P. Cyclone Overflow (4)	+75	22.2 g	2.32%	0.52	14.7%
	-75 +25	20.4 g	4.96%	1.01	28.5%
	-25	33.4 g	6.02%	2.01	56.8%
P. Cyclone Underflow (5)	+75	54.7 g	3.21%	1.76	52.1%
	-75 +25	7.1 g	11.30%	0.80	23.7%
	-25	11.3 g	7.28%	0.82	24.3%
S. Mill Discharge (8)	+75	59.3 g	4.08%	2.42	63.8%
	-75 +25	8.2 g	8.06%	0.66	17.4%
	-25	14.1 g	5.05%	0.71	18.7%
Sec. Cyclone Overflow (10)	+75	27.1 g	1.02%	0.28	11.1%
	-75 +25	18.1 g	4.62%	0.84	33.2%
	-25	28.1 g	5.02%	1.41	55.7%
Sec. Cyclone Underflow (Full) (11)	+75	60.8 g	2.72%	1.65	58.1%
	-75 +25	6.1 g	11.90%	0.73	25.7%
	-25	7.9 g	5.95%	0.46	16.2%
Sec. Cyclone U/F Split to Mill (13)	+75	63.6 g	4.01%	2.55	70.1%
	-75 +25	5.6 g	11.70%	0.66	18.1%
	-25	7.1 g	6.08%	0.43	11.8%
Skim Air Cell Conc. (14)	+75	9.2 g	67.7%	6.23	15.0%
	-75 +25	22.1 g	66.4%	14.67	35.3%
	-25	36.8 g	56.0%	20.61	49.7%

TABLE 7(B): FRACTIONAL ANALYSIS DATA
JUNE 23, 1987

Circuit Survey

Product (Number)	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Skim Air Cell Tail (15)	+75	69.1 g	3.60%	2.49	66.0%
	-75 +25	5.9 g	14.20%	0.84	22.3%
	-25	6.4 g	6.87%	0.44	11.7%
P. Flot. Ro. Tail (17)	+75	29.8 g	0.53%	0.16	19.0%
	-75 +25	18.6 g	1.67%	0.31	36.9%
	-25	23.8 g	1.55%	0.37	44.1%
Primary Ro. Conc. (18)	+75	6.0 g	27.8%	1.67	8.3%
	-75 +25	18.8 g	38.2%	7.18	34.9%
	-25	39.6 g	28.2%	11.17	55.8%
1st Cleaner Feed (19)	+75	5.9 g	18.2%	1.07	8.5%
	-75 +25	15.9 g	30.4%	4.83	38.2%
	-25	38.4 g	17.6%	6.76	53.4%
Sec. Flot. Ro. Tail (21)	+75	31.0 g	0.48%	0.15	17.9%
	-75 +25	19.2 g	1.37%	0.26	31.0%
	-25	25.9 g	1.66%	0.43	51.2%
Sec. Flot. Ro. Conc. (22)	+75	7.0 g	15.3%	1.07	13.0%
	-75 +25	14.1 g	15.3%	2.16	26.2%
	-25	43.0 g	11.7%	5.03	60.9%
1st Cleaner Tail (23)	+75	4.3 g	3.46%	0.15	5.0%
	-75 +25	15.8 g	6.20%	0.98	32.7%
	-25	44.7 g	4.19%	1.87	62.3%
Flotation (Clnr) Conc. (24)	+75	7.4 g	60.7%	4.49	9.6%
	-75 +25	22.0 g	67.3%	14.81	31.7%
	-25	43.2 g	63.4%	27.39	58.7%

TABLE 7(C): FRACTIONAL ANALYSIS DATA
JUNE 23, 1987

Circuit Survey

Product (Number)	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Scav. Slimes	+75	0.4 g	9.67%	0.04	0.9%
Conc.	-75 +25	7.0 g	8.74%	0.61	13.3%
(25)	-25	68.4 g	5.77%	3.95	85.9%
Regrind	+75	0.5 g	3.61%	0.02	0.8%
Cyclone O/F	-75 +25	10.0 g	4.65%	0.47	19.0%
(26)	-25	48.4 g	4.10%	1.98	80.2%
Regrind	+75	20.7 g	4.27%	0.88	16.9%
Cyclone U/F	-75 +25	29.3 g	10.20%	2.99	57.4%
(27)	-25	18.8 g	7.12%	1.34	25.7%
Final	+75	27.5 g	0.25%	0.07	17.9%
Tail	-75 +25	14.3 g	0.44%	0.06	15.4%
(28)	-25	26.9 g	0.98%	0.26	66.7%
Final	+75	8.2 g	58.2%	4.77	10.1%
Conc.	-75 +25	24.2 g	66.6%	16.12	34.0%
(29)	-25	41.6 g	63.6%	26.46	55.9%
Scav. Slimes	+75	0.6 g	0.56%	0.003	0.4%
Feed	-75 +25	9.2 g	1.34%	0.123	18.3%
(31)	-25	40.2 g	1.36%	0.547	81.3%
Sc[illegible] [illegible]ands	+75	31.3 g	0.38%	0.12	17.9%
Fe[illegible]	-75 +25	18.6 g	1.55%	0.29	43.3%
([illegible])	-25	13.3 g	1.98%	0.26	28.8%
Scav. Slime	+75	0.6 g	0.62%	0.004	0.8%
Tail	-75 +25	4.4 g	0.86%	0.038	7.2%
(33)	-25	44.2 g	1.10%	0.486	92.0%

TABLE 7(D): FRACTIONAL ANALYSIS DATA
JUNE 23, 1987

Circuit Survey

Product (Number)	Fraction (Microns)	Wt. Retained Each Fraction (g)	%Sb Assay Each Fraction	Metal Units Each Fraction	%Distribution Each Fraction
Scav. Sands	+75	7.3 g	7.33%	0.54	10.4%
Conc.	-75 +25	21.0 g	9.10%	1.91	36.7%
(34)	-25	47.0 g	5.85%	2.75	52.9%

Figure 9.01: Feed Streams - Pri. Cyclone O/F (4)
Sec. Cyclone O/F (10)
1st Cleaner Feed (19)

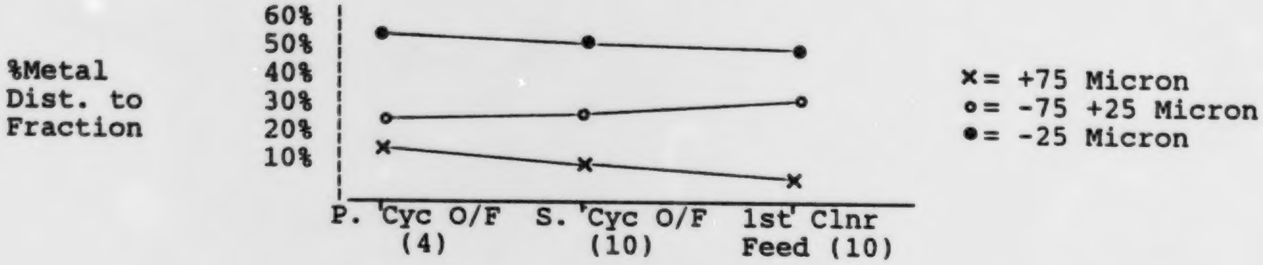


Figure 9.02:
Concentrate Streams - Skim Air Concentrate (14)
Pri. Rougher Concentrate (18)
Sec. Rougher Concentrate (22)
Flotation (Cleaner) Concentrate (24)
Final (Combined) Concentrate (29)
Scavenger Concentrate (34)

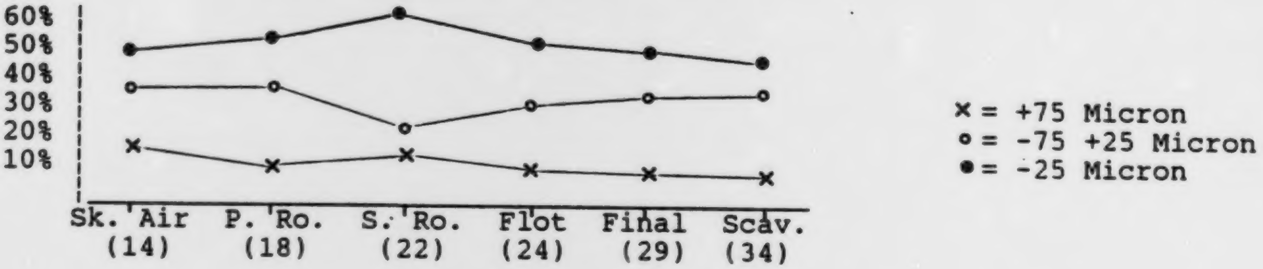


FIGURE 9: CIRCUIT SURVEY, JUNE 23, 1987. FRACTIONAL METAL DISTRIBUTION IN SIMILAR STREAMS. IE., FEED, CONCENTRATE, TAIL, RECIRCULATING, SCAVENGING AND REGRIND.

Figure 9.03: Tails Streams - Pri. Rougher Tail (17)
Sec. Rougher Tail (21)
1st Cleaner Tail (23)
Final Tail (28)

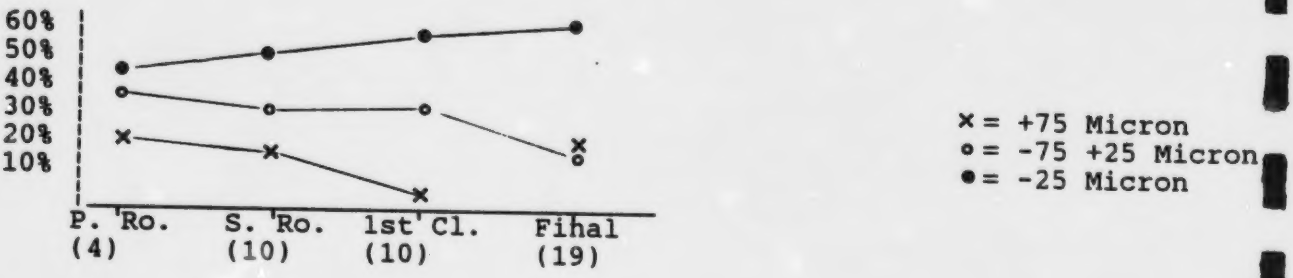


Figure 9.04: Recirculating Streams - Pri Mill Discharge (3)
Pri. Cyc. Underflow (5)
Sec. Mill Discharge (8)
Sec. Cyclone Underflow (11)
Sec. Cyclone U/F Split to Mill (13)
Skim Air Cell Tail (15)

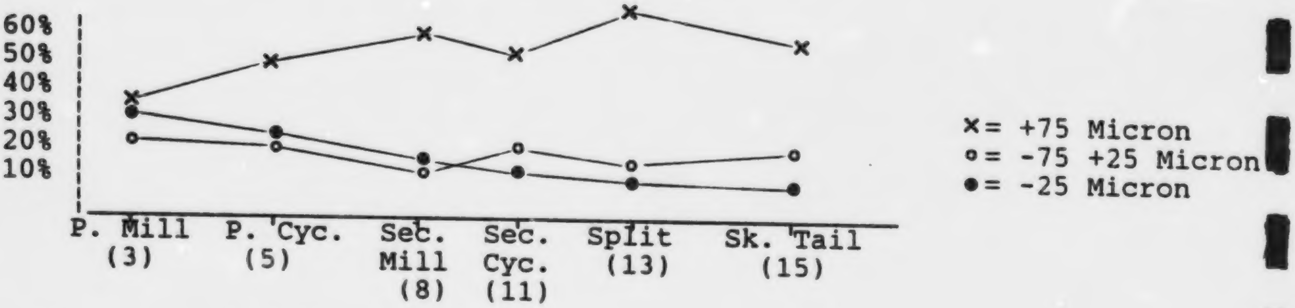


FIGURE 9: CIRCUIT SURVEY, JUNE 23, 1987. FRACTIONAL METAL DISTRIBUTION IN SIMILAR STREAMS. IE., FEED, CONCENTRATE, TAIL, RECIRCULATING, SCAVENGING AND REGRIND.

Figure 9.05: Scavenger Streams - Scavenger Slimes Feed (31)
Scavenger Slimes Conc. (25)
Scavenger Slimes Tail (33)
Scavenger Sands Feed (32)
Scavenger Sands Conc. (34)
Scavenger (Final) Tail (28)

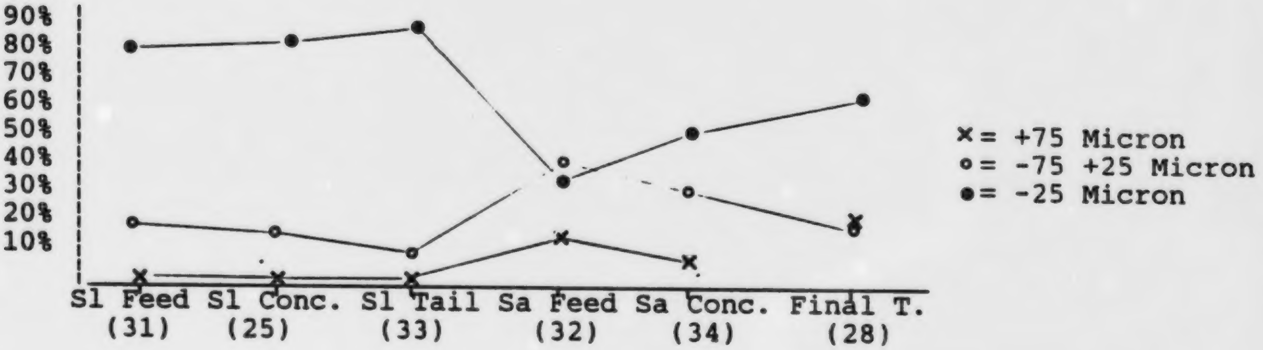


Figure 9.06: Regrind Streams - 1st Cleaner Tail (23)
Scavenger Sands conc. (34)
Regrind Cyclone U/F (27)
Regrind Cyclone O/F (26)

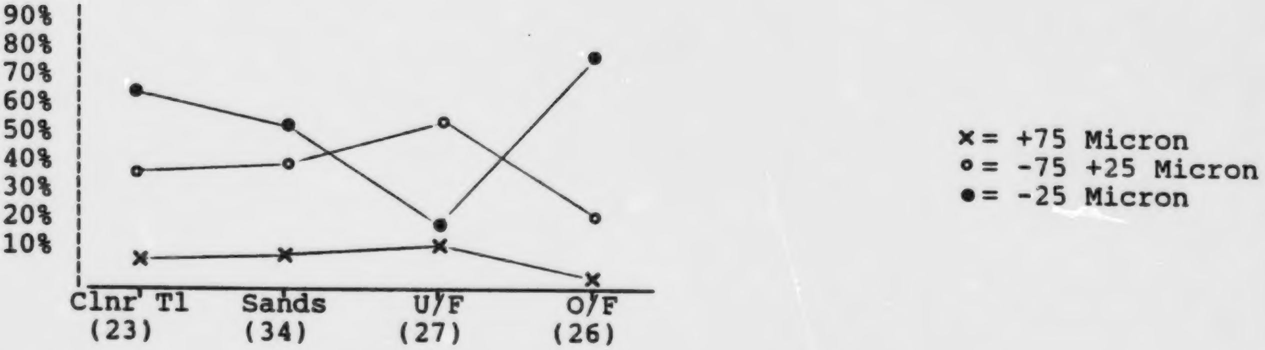


FIGURE 9: CIRCUIT SURVEY, JUNE 23, 1987. FRACTIONAL METAL DISTRIBUTION IN SIMILAR STREAMS. IE., FEED, CONCENTRATE, TAIL, RECIRCULATING, SCAVENGING AND REGRIND.

APPENDIX A.01

MINERALOGICAL REPORT M/87/008

PRE-TEST FOR SECOND RUN ON SKIM AIR CELL.

DATE:	May 25, 1987
MINERALOGICAL REPORT:	M/87/008
JOB NUMBER:	08200035/0001
SUBMITTED BY:	Durham Resources Inc. Prince William, N. B. E0H 1S0

Attn: Victor F. Hendricken

Three samples were submitted to RPC on May 18 for analysis. They are as follows:

(1)	FTAILS	April 20/21/23	RPC6701
(2)	HEADS	April 02/13/15	RPC6702
(3)	FTAILS	April 02/13/15	RPC6703

Distribution of the various antimony minerals within these samples were to be determined using the JEOL 733 electron microprobe and the KONTRON automated image analyzer. The results are shown in Figures 1, 2 and 3. The Fe-stibnite in these samples contains up to approximately 5% iron. Also please notice that due to their very similar mean atomic numbers, the minerals berthierite and gudmundite have virtually the same brightness and thus were measured together. Substantially more time is required to treat these minerals individually, although it is possible if necessary.

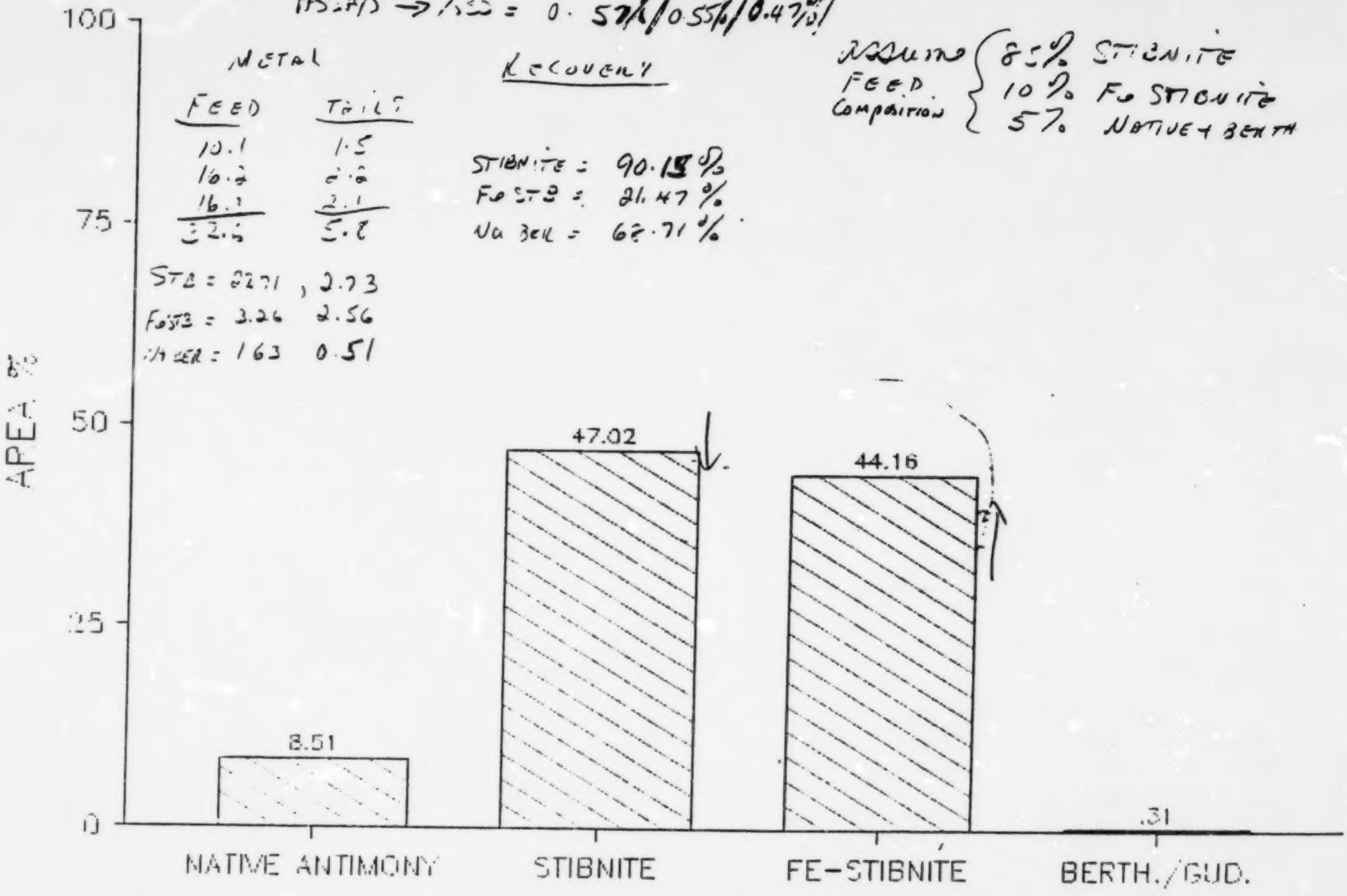
Julie Melluish
Mineralogist

JM/mb/MINRE

FIGURE 1

DISTRIBUTION OF ANTIMONY MINERALS

FTAILS APRIL 20/21/23 (SAMPLE 6701)



ASSAYS → %Sb = 0.57%/0.55%/0.47%

METAL

FEED	TAILS
10.1	1.5
16.2	2.2
16.3	2.1
42.6	5.8

STB = 22.71 , 2.73
FeSTB = 3.26 2.56
NA BER = 163 0.51

RECOVERY

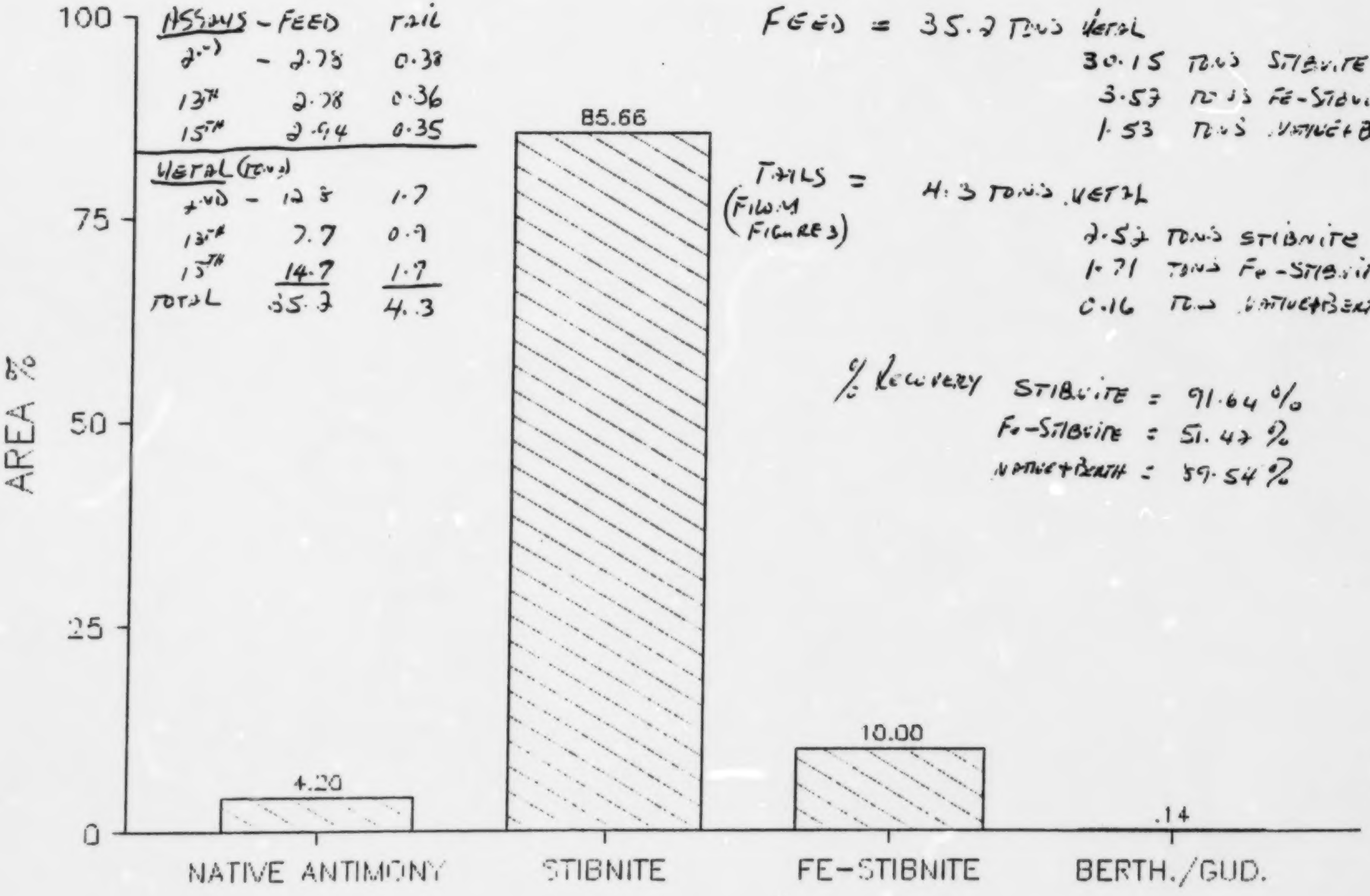
STIBNITE = 90.15%
FeSTB = 21.47%
NA BER = 68.71%

ASSUMING FEED COMPOSITION {
85% STIBNITE
10% Fe STIBNITE
5% NATIVE + BERTH

FIGURE 2

DISTRIBUTION OF ANTIMONY MINERALS

HEADS APRIL 02/13/15 (SAMPLE 6702)



ASSAYS - FEED		TAIL
2ND -	2.73	0.38
13TH	2.78	0.36
15TH	2.94	0.35
METAL (TONS)		
2ND -	12.8	1.7
13TH	7.7	0.9
15TH	14.7	1.7
TOTAL	35.2	4.3

FEED = 35.2 TONS METAL
30.15 TONS STIBNITE
3.57 TONS FE-STIBNITE
1.53 TONS NATIVE + BERTH

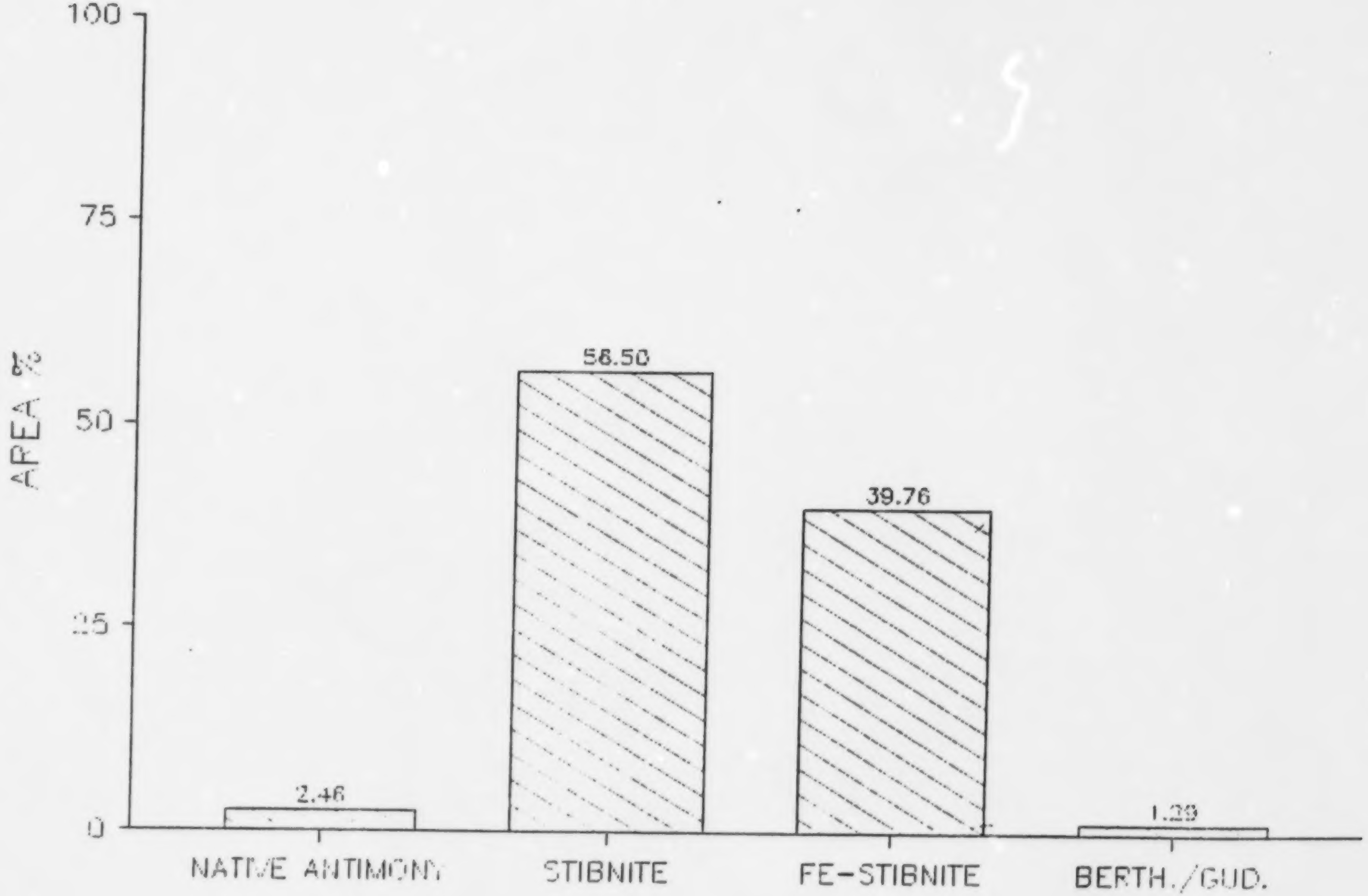
TAILS = (FROM FIGURE 3) 4.3 TONS METAL
2.57 TONS STIBNITE
1.71 TONS Fe-STIBNITE
0.16 TONS NATIVE + BERTH

% RECOVERY STIBNITE = 91.64 %
Fe-STIBNITE = 51.47 %
NATIVE + BERTH = 89.54 %

FIGURE 3

DISTRIBUTION OF ANTIMONY MINERALS

FTAILS APRIL 02/13/15 (SAMPLE 6703)



APPENDIX A.02

MINERALOGICAL REPORT M/87/013

RESEARCH AND PRODUCTIVITY COUNCIL

DATE:	July 2, 1987
MINERALOGICAL REPORT:	M/87/013
JOB NUMBER:	08200035/0002
SUBMITTED BY:	Durham Resources Inc. Prince William, N. B. E0H 1S0

Attn: Victor Hendricken

Eight samples were submitted to RPC on June 24 for analysis. Table 1 contains a list of these samples with their equivalent RPC numbers.

Distribution of the various antimony minerals within each sample was to be determined using the JEOL 733 electron microprobe and the KONTRON automated image analyzer. The results are shown in Figures 1 to 8. Note that the Fe-stibnite contains up to approximately 5% iron and, once again, berthierite and gudmundite are measured together.

In Tables 2 and 3 the number of grains measured in each sample are listed along with the number of frames examined.

Julie Melluish

Julie Melluish
Mineralogist

JM/mb/MINRE2

TABLE 1: List of Samples and Their Equivalent RPC Numbers

Sample	Size Fraction	RPC #
Heads June 01-05	-400	6800A
	+400, -200	6800B
	+200, -100	6800C
	+100	6800D
Ftails June 01-05	-400	6801A
	+400, -200	6801B
	+200, -100	6801C
	+100	6801D

NOTE
a1! Fe-Stibnite in this report is berthierite

Analyses shows 12.7Fe 13% Fe
56. → 57%

FIGURE 1

DISTRIBUTION OF ANTIMONY MINERALS
HEADS JUNE 01-05 -400 (SAMPLE 6800A)

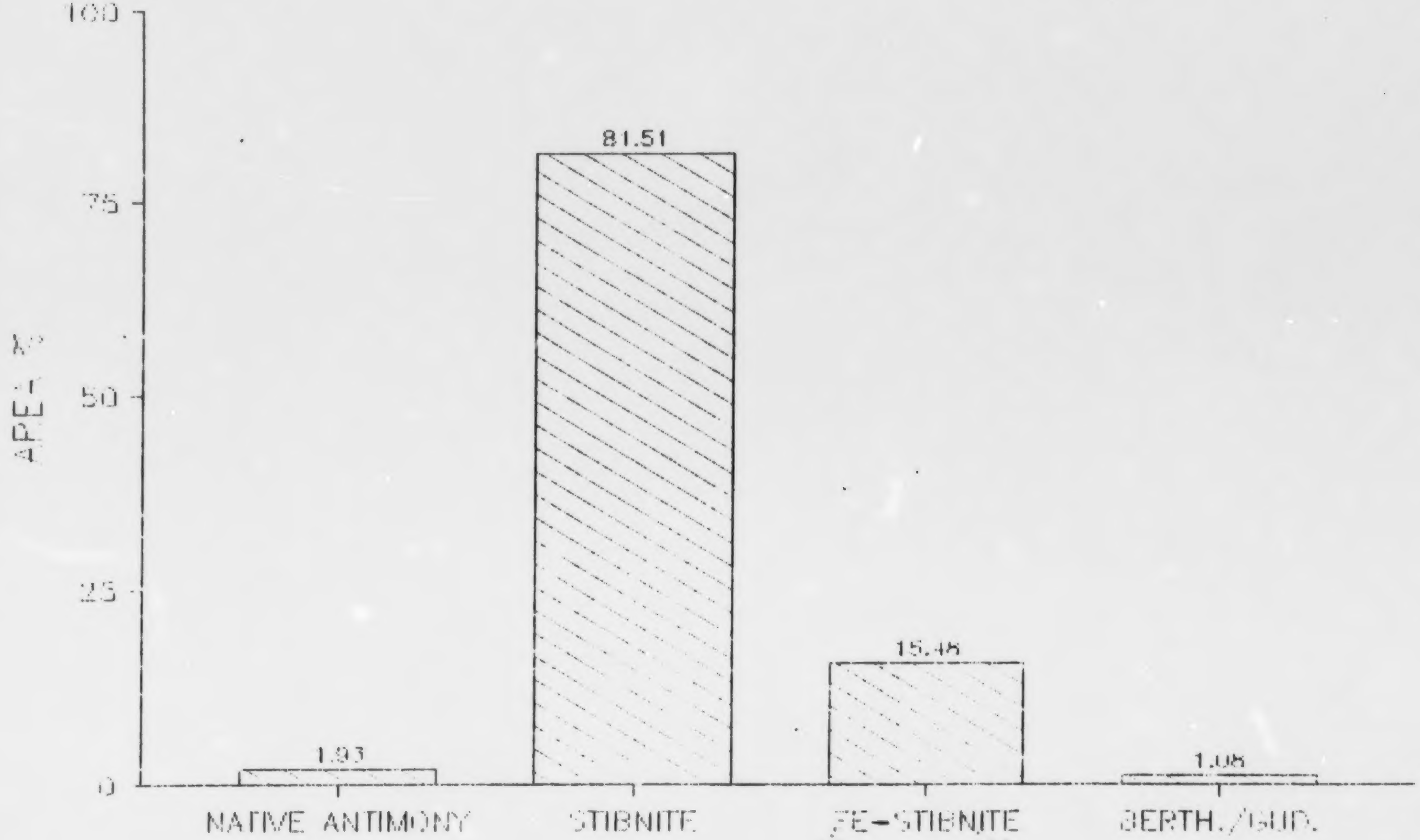


FIGURE 2

DISTRIBUTION OF ANTIMONY MINERALS
HEADS JUNE 01-05 +400,-200 (SAMPLE 6800B)

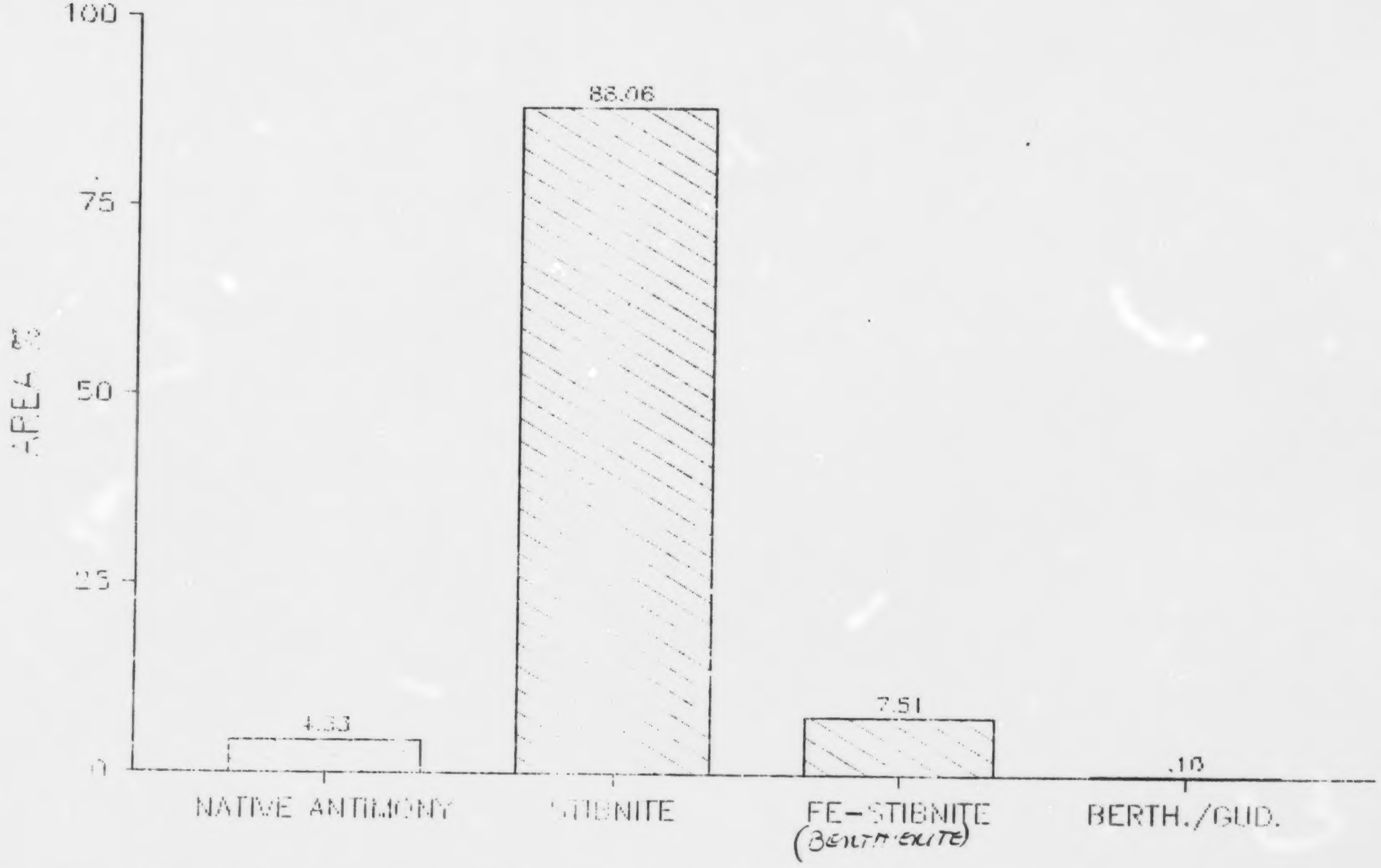


FIGURE 3

DISTRIBUTION OF ANTIMONY MINERALS
HEADS JUNE 01-05 +200,-100 (SAMPLE 6800C)

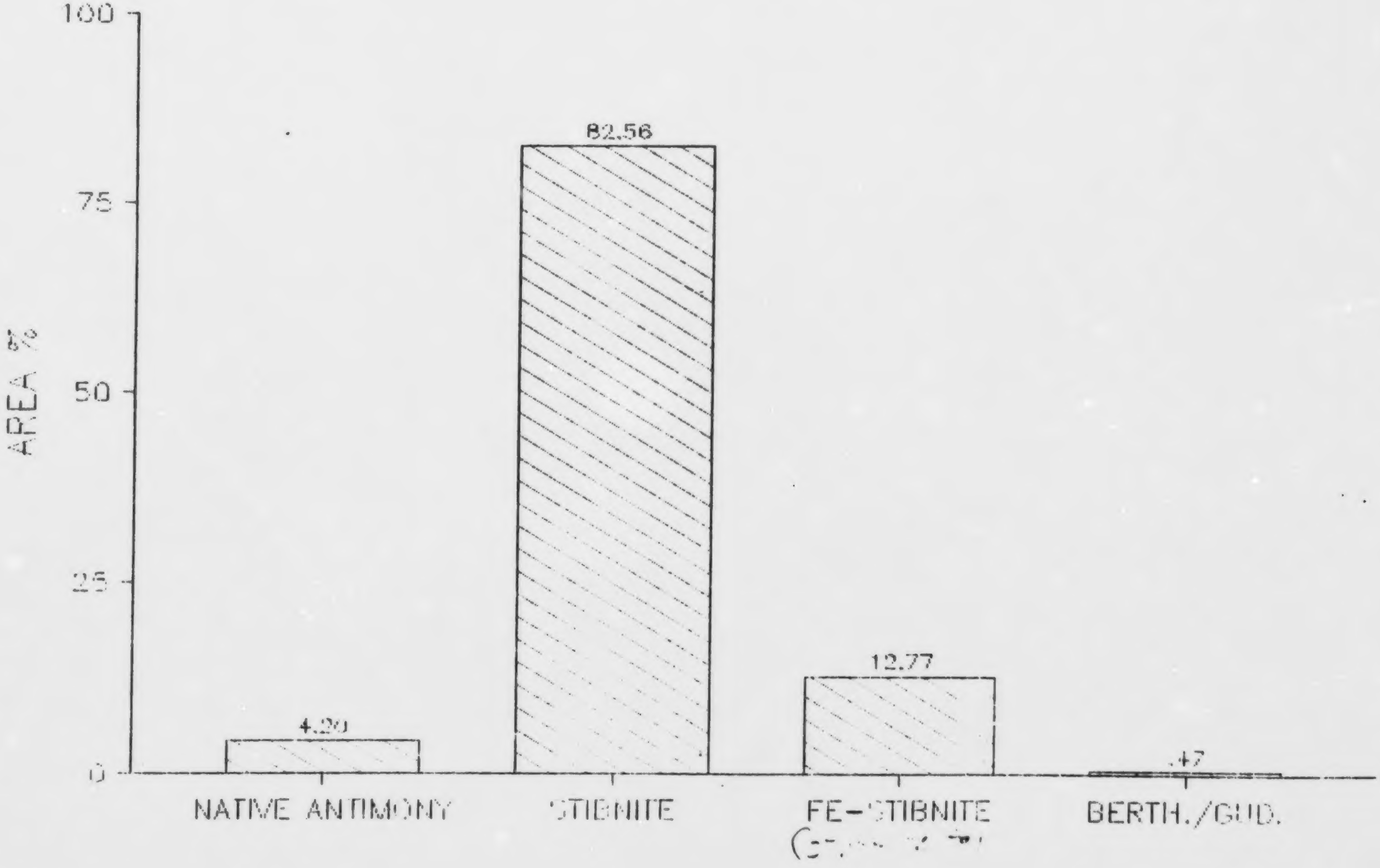
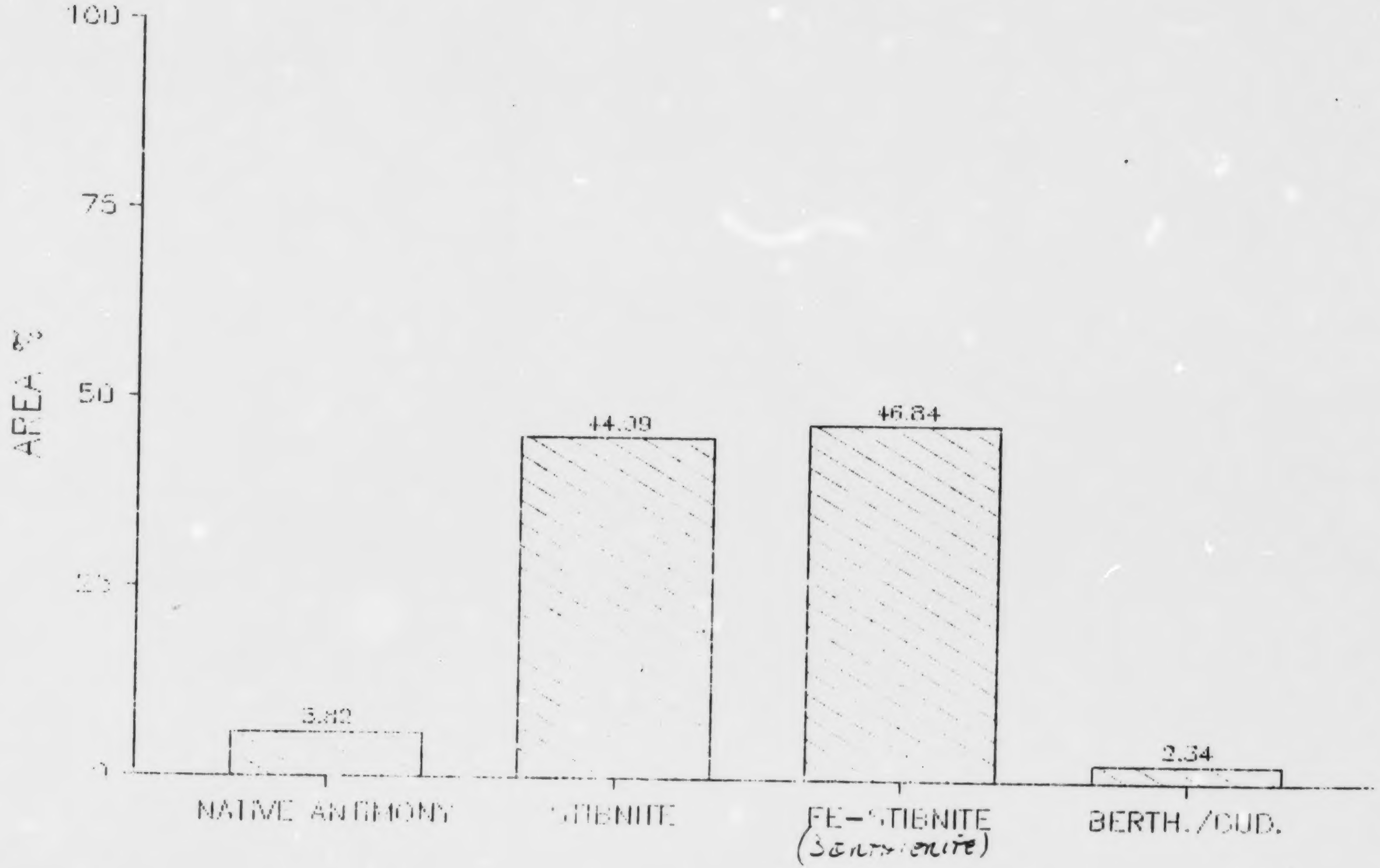


FIGURE 4



DISTRIBUTION OF ANTIMONY MINERALS
HEADS JUNE 01-05 +100 (SAMPLE 6800D)

FIGURE 5

DISTRIBUTION OF ANTIMONY MINERALS
FTAILS JUNE 01-05 -400 (SAMPLE 6801A)

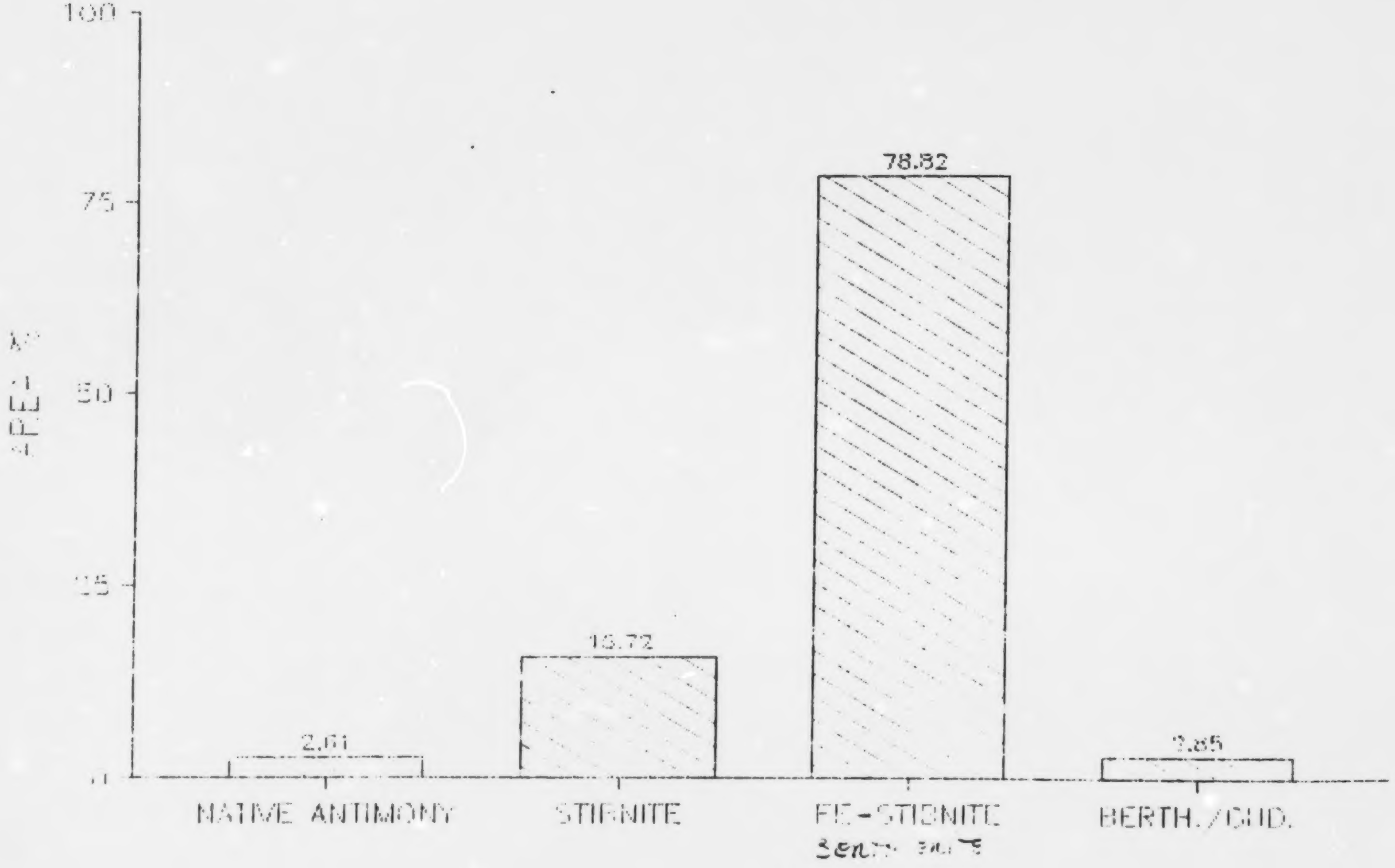


FIGURE 6

DISTRIBUTION OF ANTIMONY MINERALS
FTAILS JUNE 01-05 +400,-200 (SAMPLE 6801B)

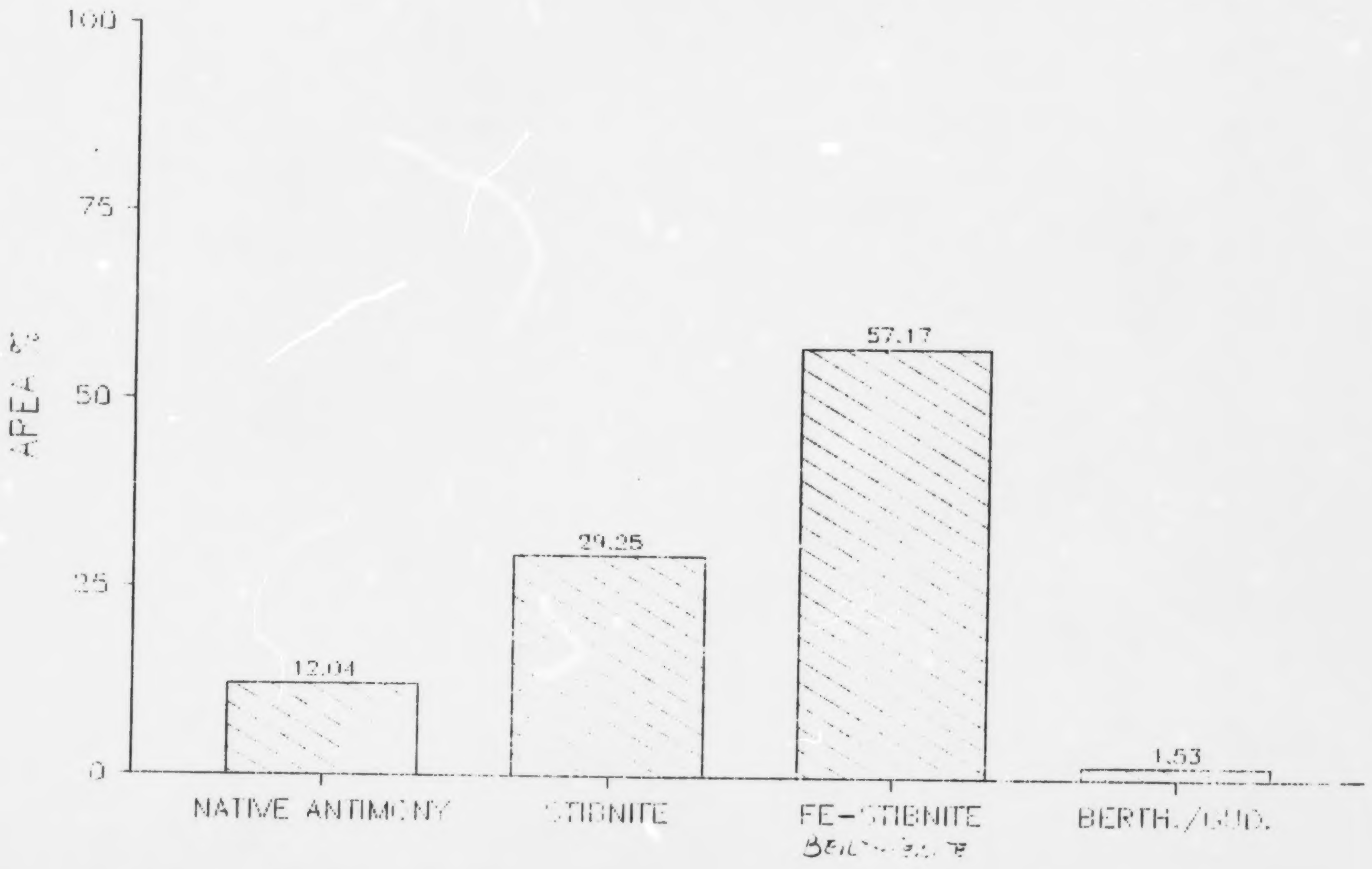


FIGURE 7

DISTRIBUTION OF ANTIMONY MINERALS
FTAILS JUNE 01-05 +200,-100 (SAMPLE 6801C)

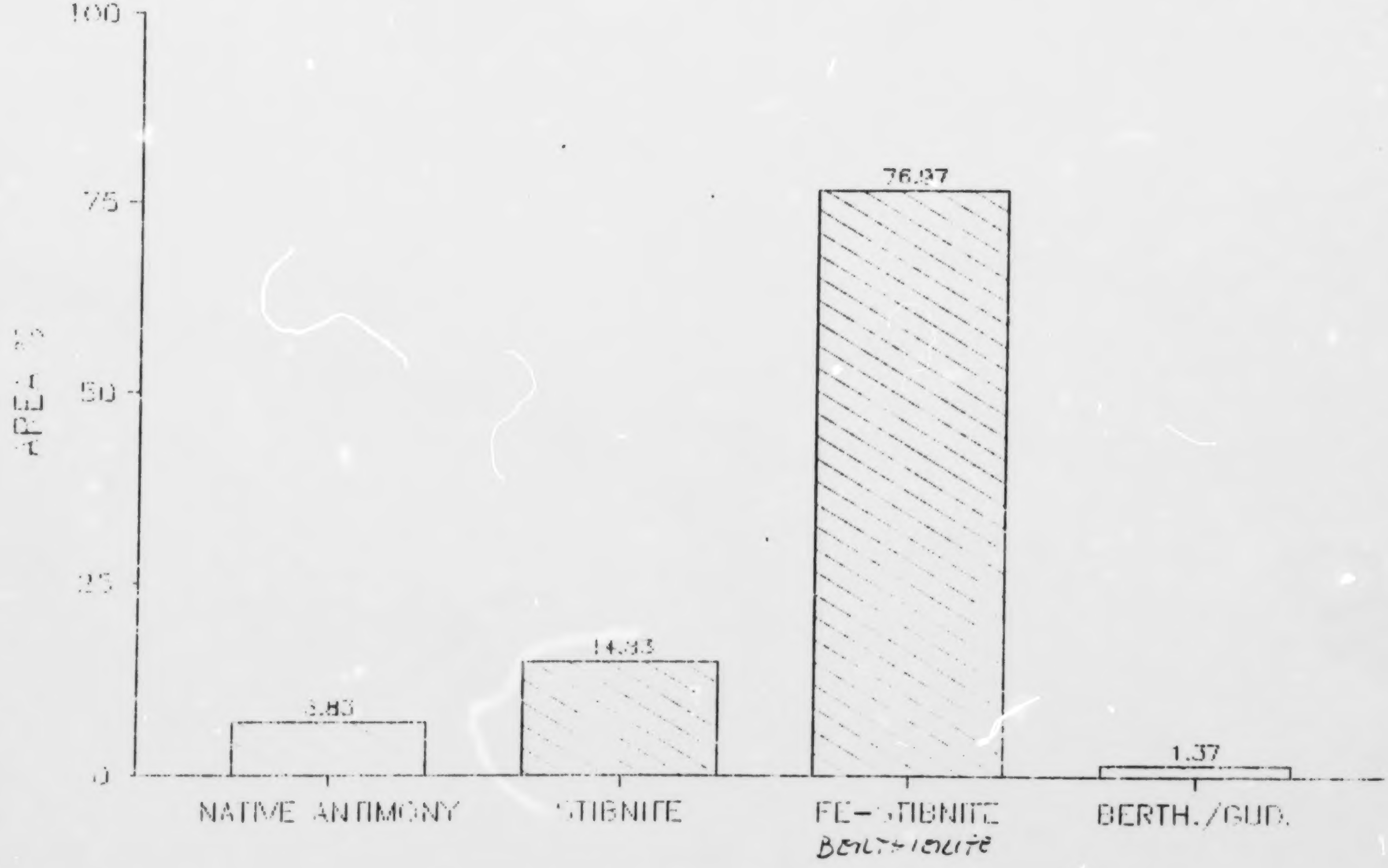


FIGURE 8

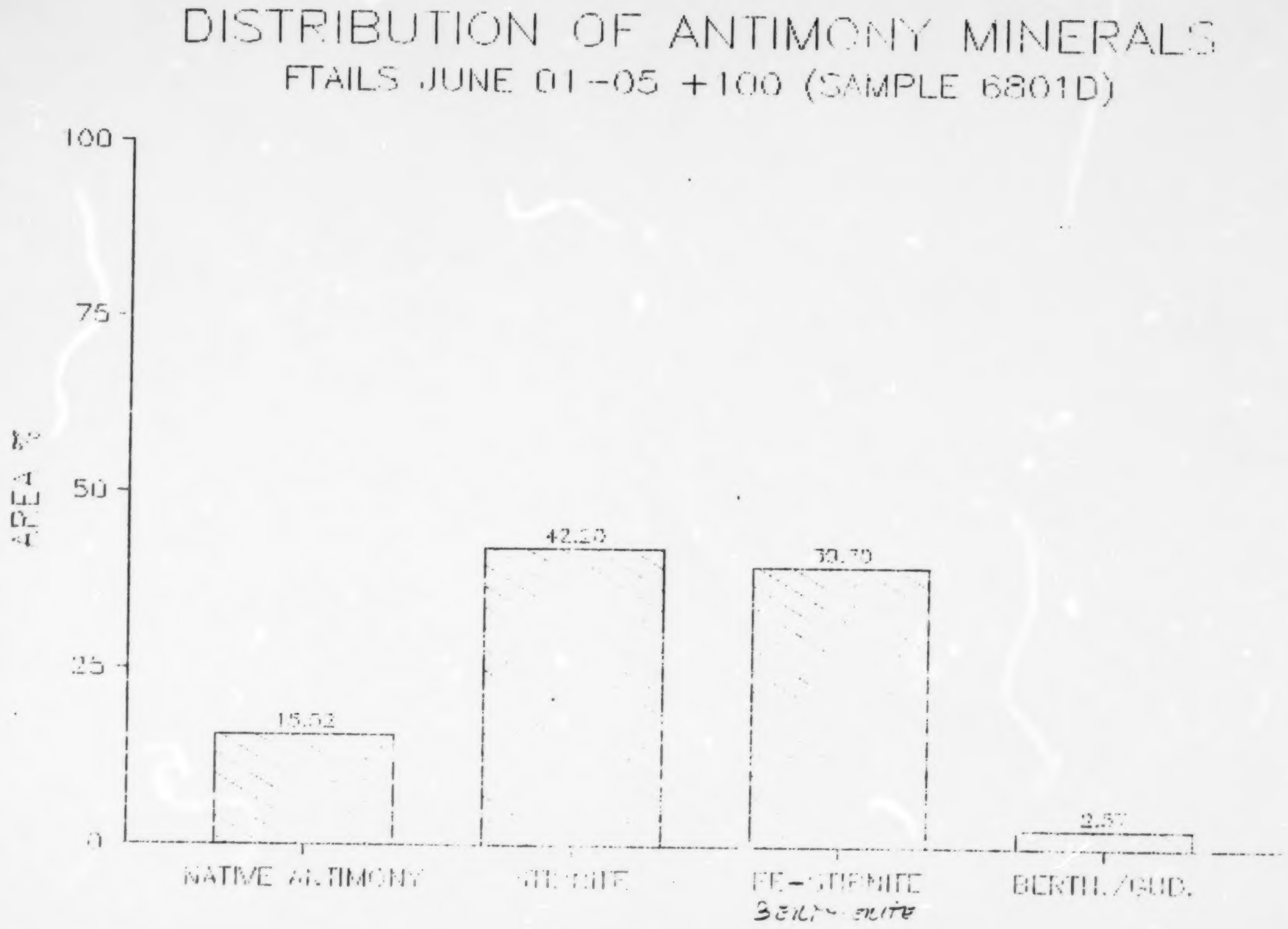

DISTRIBUTION OF ANTIMONY MINERALS
FTAILS JUNE 01-05 +100 (SAMPLE 6801D)
AREA %
100
75
50
25
0
15.52
42.20
39.70
2.57
NATIVE ANTIMONY
STIBNITE
FE-STIBNITE
Berthierite
BERTH./GUD.

TABLE 2: THE NUMBER OF GRAINS COUNTED IN THE MINERAL DISTRIBUTION STUDIES OF THE HEADS SAMPLE (JUNE 01-05).

SAMPLE:	6800A (-400)		6800B (+400,-200)	
	COUNTS	DISTRIBUTION (in %)	COUNTS	DISTRIBUTION (in %)
NATIVE ANTIMONY	43	.96	147	4.43
STIBNITE	2010	44.77	2290	69.06
FE-STIBNITE	2130	47.44	750	22.62
BERTH./GUD.	307	6.84	129	3.89
TOTAL	4490		3316	
# OF FRAMES	300		250	

SAMPLE:	6800C (+200,-100)		6800D (+100)	
	COUNTS	DISTRIBUTION (in %)	COUNTS	DISTRIBUTION (in %)
NATIVE ANTIMONY	159	3.35	36	2.91
STIBNITE	1760	37.12	569	46.07
Berth FE-STIBNITE	2400	50.62	520	42.11
BERTH./GUD.	422	8.90	110	8.91
TOTAL	4741		1235	
# OF FRAMES	281		300	

TABLE 3: THE NUMBER OF GRAINS COUNTED IN THE MINERAL DISTRIBUTION STUDIES OF THE FTAILS SAMPLE (JUNE 01-05).

SAMPLE:	6801A (-400)		6801B (+400,-200)	
	COUNTS	DISTRIBUTION (in %)	COUNTS	DISTRIBUTION (in %)
NATIVE ANTIMONY	3	.62	78	4.38
STIBNITE	86	17.84	700	39.28
FE-STIBNITE	327	67.84	739	41.47
BERTH./GUD.	66	13.69	265	14.87
TOTAL	482		1782	
# OF FRAMES	300		300	

SAMPLE:	6801C (+200,-100)		6801D (+100)	
	COUNTS	DISTRIBUTION (in %)	COUNTS	DISTRIBUTION (in %)
NATIVE ANTIMONY	63	5.40	52	7.03
STIBNITE	318	27.27	240	32.43
FE-STIBNITE	660	56.60	400	54.05
BERTH./GUD.	125	10.72	48	6.49
TOTAL	1166		740	
# OF FRAMES	298		300	

TABLE 4: AREA % AND WEIGHT % DISTRIBUTIONS FOR THE HEADS SAMPLE (JUNE 01-05). THE SPECIFIC GRAVITY VALUES USED FOR THE WEIGHT % DISTRIBUTIONS ARE AS FOLLOWS: NATIVE ANTIMONY 6.688, STIBNITE AND BERTHIERITE 4.65, AND GUDMUNDITE 6.13. SAMPLE CALCULATION FOR NATIVE ANTIMONY IN SAMPLE 6800A:

AREA% x S.G. = WEIGHTED AREA% (WTED AREA%)
1.93 x 6.688 = 12.91

(WTED AREA% . TOTAL WTED AREA%) x 100 = WEIGHT %
(12.91 . 470.38) x 100 = 2.74

SAMPLE:	6800A (-400)			6800B (+400,-200)		
	AREA (in %)	WEIGHTED AREA % (in %)	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA % (in %)	WEIGHT % (normalized weighted area %)
NATIVE ANTIMONY	1.93	12.91	2.74	4.33	28.96	6.11
STIBNITE	81.51	379.02	80.58	88.06	409.48	86.41
BERTHIERITE	15.48	71.83	15.27	7.51	34.85	7.35
BERTH./GUD.	1.08	6.62	1.41	.10	.61	.13
TOTAL		470.38			473.90	

SAMPLE:	6800C (+200,-100)			6800D (+100)		
	AREA (in %)	WEIGHTED AREA % (in %)	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA % (in %)	WEIGHT % (normalized weighted area %)
NATIVE ANTIMONY	4.20	28.09	5.92	5.82	38.92	8.11
STIBNITE	82.56	383.90	80.97	44.99	209.20	43.60
BERTHIERITE	12.77	59.25	12.50	46.84	217.34	45.30
GUDMUNDITE	.47	2.88	.61	2.34	14.34	2.99
TOTAL		474.13			479.81	

TABLE 5: AREA % AND WEIGHT % DISTRIBUTIONS FOR THE FIAILS SAMPLE (JUNE 01-[illegible]) THE SPECIFIC GRAVITY VALUES USED FOR THE WEIGHT % DISTRIBUTIONS ARE AS FOLLOWS: NATIVE ANTIMONY 6.688, STIBNITE AND BERTHIERITE 4.65 AND GUDMUNDITE 6.13. SAMPLE CALCULATION FOR NATIVE ANTIMONY IN SAMPLE 6801A:

AREA% × S.G. = WEIGHTED AREA% (WTED AREA%)
2.61 × 6.688 = 17.46

(WTED AREA% . TOTAL WTED AREA%) × 100 = WEIGHT %
(17.46 . 473.75) × 100 = 3.68

SAMPLE:	6801A (-400)			6801B (+400,-200)		
	AREA (in %)	WEIGHTED AREA % (in %)	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA % (in %)	WEIGHT % (normalize weighted area %)
NATIVE ANTIMONY	2.61	17.46	3.68	12.04	80.52	16.39
STIBNITE	15.72	73.10	15.43	29.25	136.01	27.69
BERTHIERITE	78.82	365.72	77.20	57.17	265.27	54.01
GUDMUNDITE	2.85	17.47	3.69	1.53	9.38	1.91
TOTAL		473.75			491.18	

SAMPLE:	6801C (+200,-100)			6801D (+100)		
	AREA (in %)	WEIGHTED AREA % (in %)	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA % (in %)	WEIGHT % (normalize weighted area %)
NATIVE ANTIMONY	6.83	45.68	9.51	15.52	103.80	20.76
STIBNITE	14.83	68.96	14.36	42.20	196.23	39.25
BERTHIERITE	76.97	357.14	74.38	39.70	184.21	36.84
GUDMUNDITE	1.37	8.40	1.75	2.57	15.75	3.15
TOTAL		480.18			499.99	

APPENDIX A.03

MINERALOGICAL REPORT M/87/015

DATE: July 28, 1987
MINERALOGICAL REPORT: M/87/015
JOB NUMBER: 08200035/0001
SUBMITTED BY: Durham Resources Inc.
Prince William, N. B.
E0H 1S0
Attn: Victor F. Hendricken

Seven samples were submitted to RPC on July 17, 1987, for analysis. Table 1 lists the samples, the equivalent RPC numbers, and the type of analysis done.

The JEOL 733 electron microprobe and the KONTRON automated image analyzer were used to determine the distribution of antimony phases and the liberation state of berthierite in sample 6819. The results are presented in Figure 1 and Tables 2, 3 and 4. Figure 1 contains the distribution of antimony minerals based on measured surface area of each phase. The values have been normalized. In Table 2 the number of grains of each phase measured and the normalized distribution of these grains are listed along with the number of frames examined. Table 3 presents the weight % distribution based on the measured surface area distribution. In Table 4 the liberation state of the berthierite is presented based on the number of grains and arranged in 11 size classes. A more detailed description of the material in the various size classes is given in Appendix 1. In general it appears that the 5% berthierite (see Figure 1) contained in the concentrate is fine-grained and liberated. The locked berthierite in the size fractions below 4.54 micron is generally less than 50% of the whole grain whereas in the +4.54 micron size fractions it is greater than 50% (see Table 4). Note that the percent of berthierite in each whole grain was estimated visually. Most of this locked material is either included in or intergrown with stibnite (see Appendix 1). Only one grain of the 656 examined was locked in quartz.

Table 1: List of Samples, Their RPC Numbers, and Type of Analysis

Sample	RPC	Type of Analysis
Concentrate June 01-05	6819	mineral distribution and liberation of berthierite
one large stibnite(?) needle, stope 444	6820	identification
numerous small needles, stope 1120	6821	identitication
large rock sample, stope 1120	6822	optical examination
"blue" mineral, stope 1120	6823	optical examination and identification
massive stibnite(?), stope 1120	6824	optical examination
pyrrhotite(?), stope 1120	6825	optical examination

FIGURE 1

DISTRIBUTION OF ANTIMONY MINERALS
CONCENTRATE JUNE 01–05 (SAMPLE 6819)

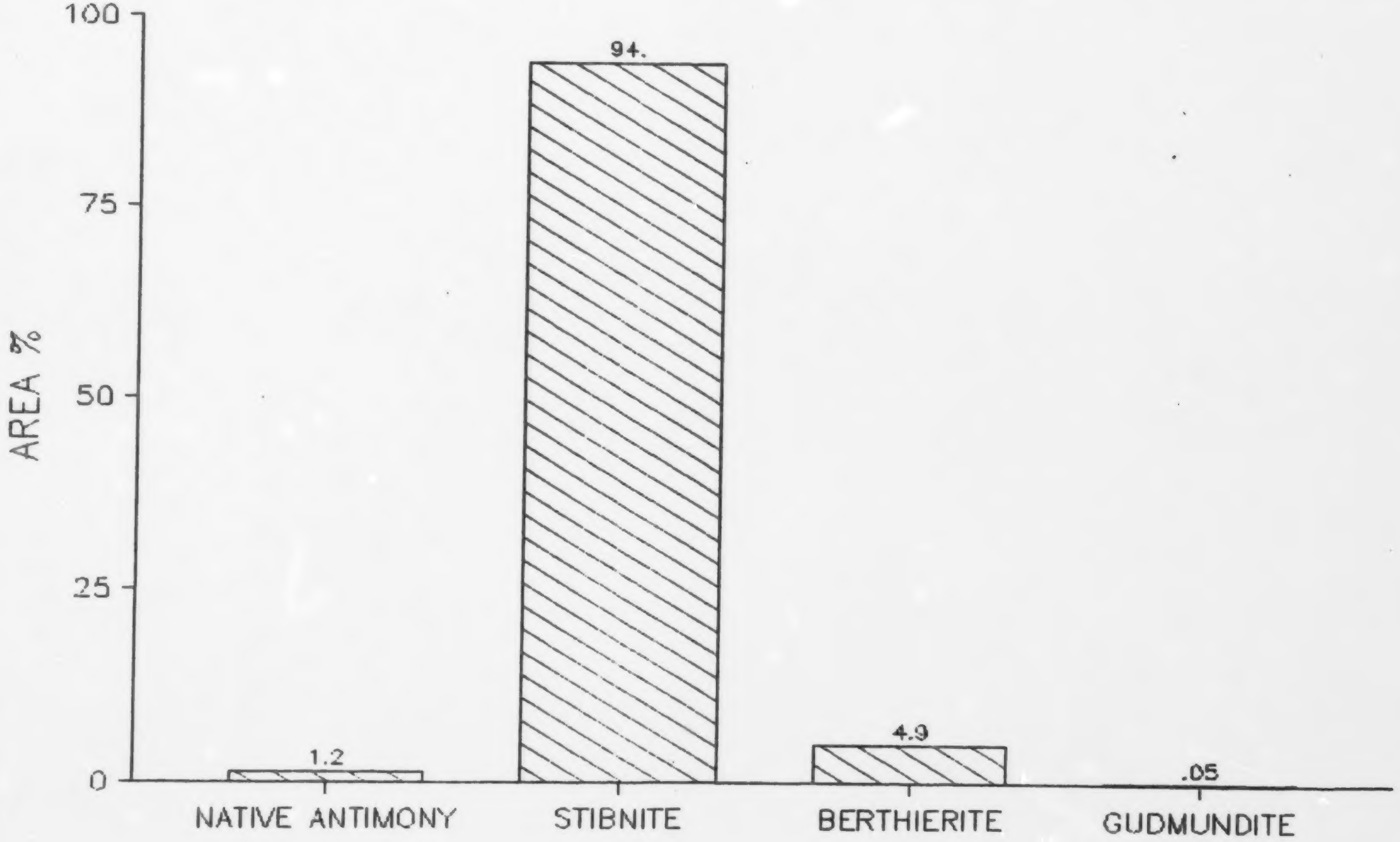


TABLE 2: THE NUMBER OF GRAINS COUNTED IN THE MINERAL DISTRIBUTION STUDIES OF THE ~~[illegible]~~ CONC SAMPLE (JUNE 01-05).

SAMPLE:	6819	
	COUNTS	DISTRIBUTION (in %)
NATIVE ANTIMONY	1670	1.86
STIBNITE	77200	85.82
FE-STIBNITE	10100	11.23
BERTH./GUD.	981	1.09
TOTAL	89951	
# OF FRAMES	290	

TABLE 8: AREA % AND WEIGHT % DISTRIBUTIONS FOR THE [redacted] CONC SAMPLE (JUNE 01-05). THE SPECIFIC GRAVITY VALUES USED FOR THE WEIGHT % DISTRIBUTIONS ARE AS FOLLOWS: NATIVE ANTIMONY 6.688, STIBNITE AND BERTHIERITE 4.65, AND GUDMUNDITE 6.13. SAMPLE CALCULATION FOR NATIVE ANTIMONY IN SAMPLE 6800A:

AREA% × S.G. = WEIGHTED AREA% (WTED AREA%)
1.20 × 6.688 = 8.03

(WTED AREA% ÷ TOTAL WTED AREA%) × 100 = WEIGHT %
(8.03 ÷ 467.47) × 100 = 1.72

SAMPLE: 6819

	AREA (in %)	WEIGHTED AREA % (in %)	WEIGHT % (normalized weighted area %)
NATIVE ANTIMONY	1.20	8.03	1.72
STIBNITE	93.86	436.45	93.36
BERTHIERITE	4.89	22.69	4.85
GUDMUNDITE	.05	.31	.07
TOTAL		467.47	

Table 4: Liberation of Berthierite in Sample 6819. Note that no grains of berthierite were observed in the (+51.9, -73.4) size fraction.

Size Fraction (microns)	# of Grains (counts, % counts)	Distribution (area %)	Liberated (counts)	Locked (counts)	Distribution of locked material as % of whole grain (counts)				
					<10%	10-25%	25-50%	50-75%	75-95%
-2.27	484 (73.8%)	8.6%	416	68	33	18	11	6	0
+2.27,-3.21	79 (12.0%)	3.5%	68	11	3	4	3	1	0
+3.21,-4.54	29 (4.4%)	2.8%	22	7	4	0	1	2	0
+4.54,-6.43	21 (3.2%)	3.9%	18	3	0	0	0	2	1
+6.43,-9.11	20 (3.0%)	7.7%	16	4	1	1	0	1	1
+9.11,-12.9	8 (1.2%)	6.4%	5	3	0	0	1	1	1
+12.9,-18.3	6 (0.9%)	10.6%	4	2	0	0	0	1	1
+18.3,-25.9	3 (0.5%)	8.7%	2	1	0	0	0	1	0
+25.9,-36.6	5 (0.8%)	29.8%	3	2	0	0	1	1	0
+36.6,-51.9	0	—	—	—	—	—	—	—	—
+51.9,-73.4	1 (0.2%)	18.0%	1	0	0	0	0	0	0
Total	656 (100%)	100%							

The one large needle (sample 6120) and several small needles (sample 6121) were analyzed semi-quantitatively and identified as stibnite. They contained no iron.

The four rock samples were cut and seven polished sections were prepared for optical examination. Four of the polished sections and one small rock sample were also examined in the electron microprobe to confirm several observations. All the samples were found to contain unusual amounts of berthierite and/or gudmundite. A more detailed description of each sample follows.

Sample 6822 (large rock sample) contains fine to medium grained acicular stibnite. The larger stibnite crystals are often clumped into "rosettes". Locally fine feathery berthierite occurs with stibnite that contains small inclusions of native antimony (see Figure 2). Rare euhedral to subhedral arsenopyrite crystals are also found in the stibnite. Gudmundite is another very common antimony-bearing phase in this sample. It occurs as irregular blebby grains intergrown with the stibnite and blebby veins within quartz. Blades of pyrrhotite are commonly associated with the gudmundite (see Figure 3).

A blue mineral was observed on the surface of Sample 6823. Examination of the surface revealed no unusual minerals. Berthierite, quartz and calcite were the only minerals identified. Within the polished section made from material containing this mineral on its surface no unusual minerals were observed. The sample contains massive to fine acicular berthierite in calcite and quartz. One large spongy grain of pyrite was observed within the massive berthierite.

In Sample 6824 (massive stibnite?) the predominant antimony mineral is berthierite. It occurs as spongy massive, feathery and fine acicular material (see Figure 4). Small inclusions of stibnite and native antimony occur within the more massive material. Massive stibnite often associated with clumps of native antimony also occur

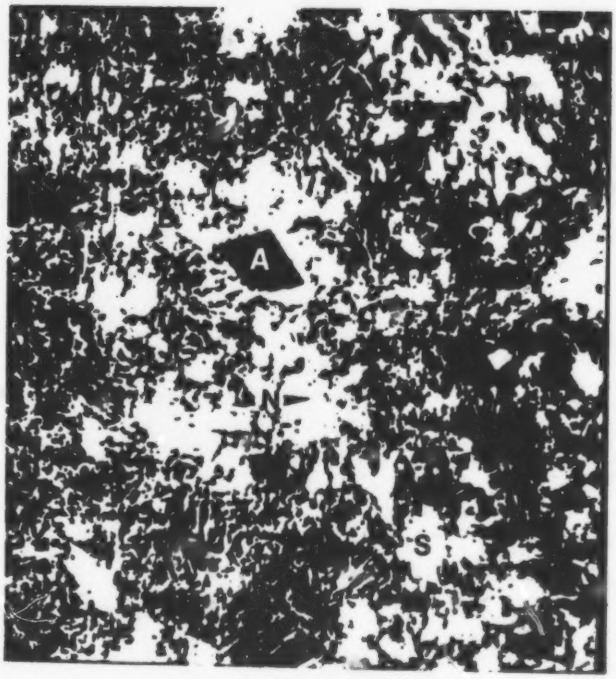
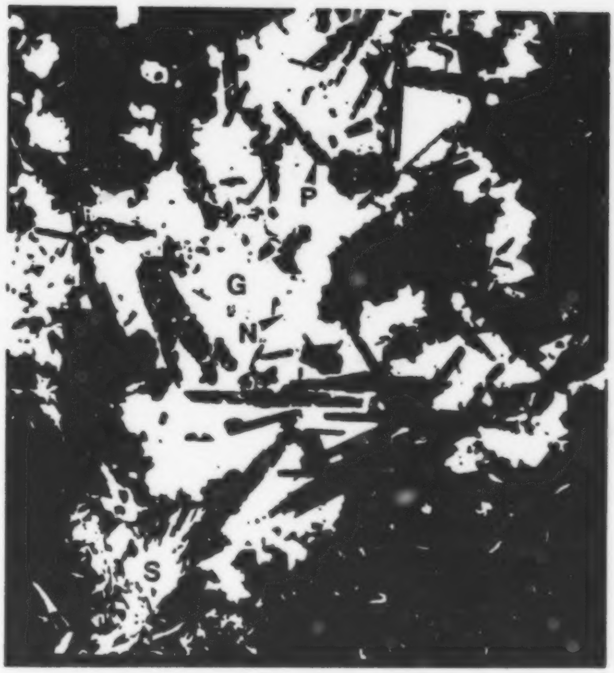
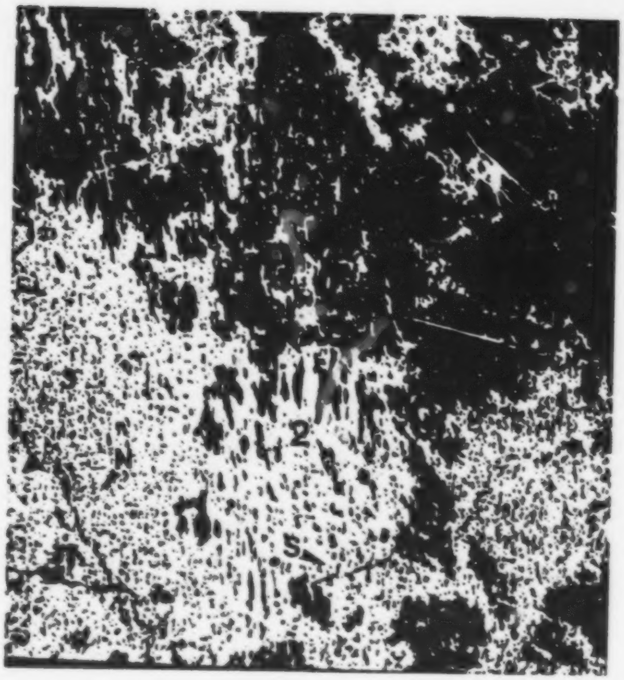


Figure 2: Fine feathery Berthierite (B) with Intergrown Stibnite (S) and Native Antimony (N). The black euhedral crystal in the centre of the photo is arsenopyrite (A). (Backscattered Electron Image, Sample 6822).



250 Micron

Figure 3: Spongy Gudmundite (G) intergrown with bladed Pyrrhotite (P). Inclusions of native antimony (N) are common within the gudmundite. Notice the clump of acicular stibnite (S) in the lower left hand corner. (Backscattered Electron Image, Sample 6822).



250 Micron

Figure 4: Spongy Massive (1), Feathery (2) and Fine Acicular (3) Berthierite with Small Inclusions of Stibnite (S) and Native Antimony (N). (Backscattered Electron Image, Sample 6824).

locally with the berthierite (see Figure 5). Rare euhedral arsenopyrite grains were observed.

Berthierite is the predominant mineral in Sample 6825 (pyrrhotite(?)). It exhibits irregular banding defined by crystal habit and the amount of phase present (see Figure 6). The crystals exhibit a tabular to acicular lineated or a coarse nonlineated acicular to massive habit. The fine lineated material contains numerous large (200-500 micron across) porphyroblasts comprised of spongy pyrite and varying amounts of quartz and alteration material. Within the coarse berthierite smaller dense pyrite grains occur, although much less commonly than the spongy porphyroblasts in the fine berthierite.

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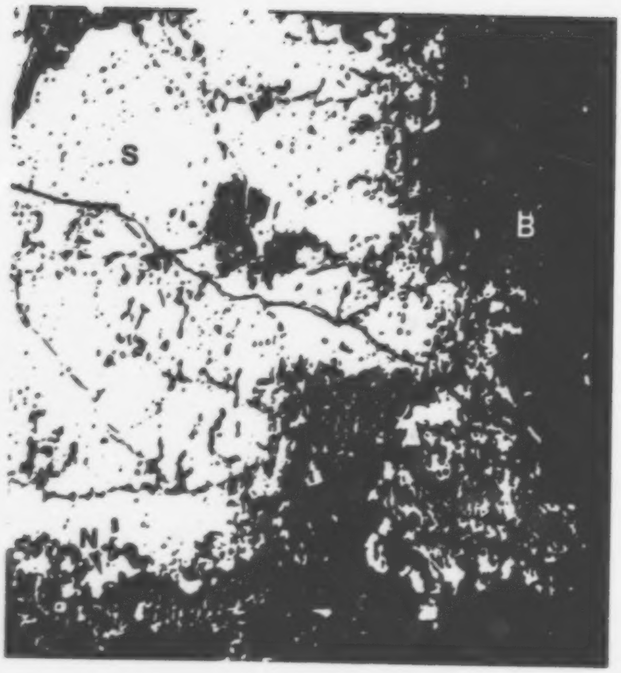
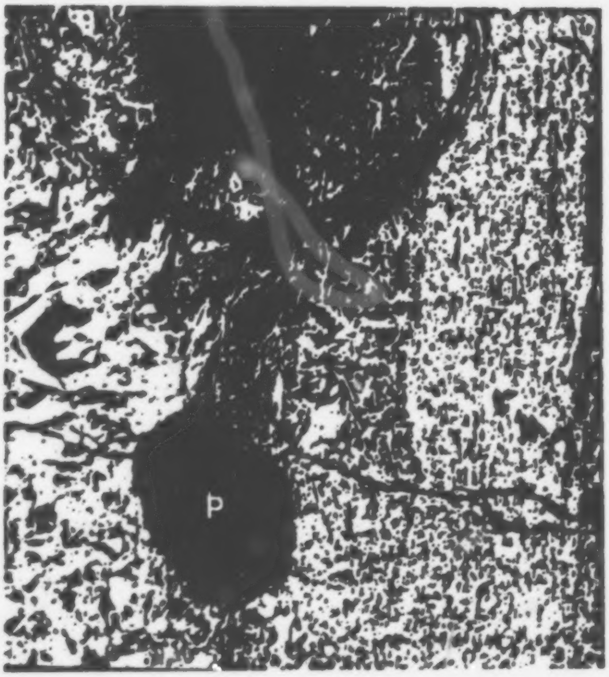


Figure 5: Massive Stibnite (S) Associated with Clumps of Native Antimony (N) and Berthierite (B). (Backscattered Electron Image, Sample 6824).



250 Micron

Figure 6: Irregular Banding of Berthierite. The habit of the berthierite varies from tabular lineated (almost massive) (1) to acicular and somewhat less lineated (2) to large nonlineated acicular (almost massive) (3). Note the large porphyroblast (P) at the bottom of the photograph. (Back-scattered Electron Image, Sample 6825).

APPENDIX 1

Details of 656 Berthierite Grains
in Sample 6819
(Concentrate, June 01-05)

Details of Berthierite in Concentrate, June 01-05

Size Fraction	% of Whole Particle	Description
-2.27 micron locked 68 liberated 416	<10%	33 grains in 19 large stibnite particles, 2 of which contain <5% native antimony inclusions also.
	10-25%	18 grains in 8 large to medium stibnite particles, 2 of which contain larger berthierite inclusions also.
	25-50%	11 grains in 9 medium stibnite particles.
	50-75%	6 grains intergrown with stibnite in 4 particles.
	75-95%	none
	Liberated	416 massive berthierite particles.
+2.27,-3.21 micron locked 11 liberated 68	<10%	3 grains in 3 stibnite particles, 2 of which contain smaller berthierite inclusions also.

Details of Berthierite (Cont'd)

Size Fraction	% of Whole Particle	Description
+2.27,-3.21 micron (cont'd)	10-25%	4 grains in 3 stibnite particles with smaller berthierite inclusions.
	25-50%	3 grains in 3 stibnite particles, one of which contains a larger berthierite inclusion.
	50-75%	1 grain intergrown with stibnite.
	75-95%	none
	Liberated	68
+3.21,-4.54 locked 7 liberated 11	<10%	4 grains in 3 stibnite and one arsenopyrite particle with smaller berthierite inclusions also.
	10-25%	none
	25-50%	1 grain in stibnite.
	50-75%	2 grains intergrown with stibnite in 2 particles.

Details of Berthierite (Cont'd)

Size Fraction	% of Whole Particle	Description
+3.21,-4.54 micron (cont'd)	75-95%	none.
+4.54,-6.43 micron locked 3 liberated 18	<10%	none.
	10-25%	none.
	25-50%	none.
	50-75%	2 grains intergrown with stibnite in 2 particles, one particle contains other larger and smaller berthierite inclusions.
	75-95%	1 grain coarsely intergrown with 15% stibnite.
	Liberated	18 massive berthierite particles.

Details of Berthierite (Cont'd)

Size Fraction	% of Whole Particle	Description
+6.43,-9.11 micron locked 4 liberated 16	<10%	1 grain in a large stibnite particle with several smaller berthierite inclusions.
	10-25%	1 grain in 1 stibnite particle.
	25-50%	none.
	50-75%	1 grain intergrown with native antimony.
	75-95%	1 particle with approximately 20% stibnite intergrowth.
	Liberated	16 massive berthierite particles.
+9.11,-12.9 micron locked 3 liberated 5	<10%	none.
	10-25%	none.

Details of Berthierite (Cont'd)

Size Fraction	% of Whole Particle	Description
+9.11,-12.9 micron (cont'd)	<10%	1 grain in a large stibnite particle with several smaller berthierite inclusions.
	10-25%	none.
	25-50%	1 grain in 1 stibnite particle with several smaller berthierite inclusions.
	50-75%	1 grain intergrown with stibnite in an acicular particle.
	75-95%	1 berthierite particle with approximately 10% stibnite inclusions.
	liberated	5 massive berthierite particles, 2 of which contain <5% stibnite inclusions.

Details of Berthierite (Cont'd)

Size Fraction	% of Whole Particle	Description
+12.9,-18.3 micron locked 2 liberated 4	<10%	none.
	10-25%	none.
	25-50%	none.
	50-75%	1 grain coarsely intergrown with approximately 35% stibnite and arsenopyrite.
	75-95%	1 berthierite particle with approximately 15% stibnite inclusions.
	liberated	4 massive berthierite particles, 3 of which contain <5% stibnite inclusions.

Details of Berthierite (Cont'd)

Size Fraction	% of Whole Particle	Description
+18.3,-25.9 micron locked 1 liberated 2	<10%	none.
	10-25%	none.
	25-50%	none.
	50-75%	1 grain coarsely intergrown with approximately 40% stibnite.
	75-95%	none.
	liberated	2 massive berthierite particles.
+25.9,-36.6 micron locked 2 liberated 3	<10%	none.

Details of Berthierite (Cont'd)

Size Fraction	% of Whole Particle	Description
+25.9,-36.6 micron (cont'd)	10-25%	1 quartz particle containing intergrown acicular grains and <5% native antimony as inclusions.
	25-50%	1 quartz particle containing intergrown acicular berthierite grains and <5% native antimony as inclusions.
	50-75%	1 berthierite particle containing banded intergrowths of stibnite.
	75-95%	none.
	liberated	3 massive berthierite particles, 2 of which contain <5% stibnite inclusions.
+36.6,-51.9	no grains of this size were observed.	

Details of Berthierite (Cont'd)

Size Fraction	% of Whole Particle	Description
+51.9,-73.4 locked 0 liberated 1	<10%	none.
	10-25%	none.
	25-50%	none.
	50-75%	none.
	75-95%	none.
	liberated	1 massive berthierite particle.

APPENDIX A.04

MINERALOGICAL REPORT M/87/028

DATE: September 29, 1987
MINERALOGICAL REPORT: M/87/028
JOB NUMBER: 08200035/0004
SUBMITTED BY: Durham Resources Inc.
Prince William, N. B.
E0H 1S0
Attn: Victor Hendricken

Thirty-four samples were submitted to RPC on September 4th, 1987, for analysis. This report contains mineral distribution results for the twenty-two concentrates listed in Table 1. The results for the remaining twelve samples will follow in the next report.

The JEOL 733 electron microprobe interfaced with the KONTRON automated image analyzer was used to determine the distribution of the antimony phases - native antimony, stibnite, berthierite, and gudmundite. Tables 2 and 3 contain the mineral distribution data based on surface area, weighted area, and frequency (number of grains). Appendix A-1 contains the graphical representations of the distribution data based on surface area. In Appendix A-2 and A-3 calculations are shown for the weighted area distributions and the frequency distributions, respectively. Appendix A-3 also includes the number of frames examined. Note that because the samples are concentrates many antimony mineral grains are measured in each frame. Thus, less frames must be measured per sample to examine an adequate amount of material. Also, it takes more time to measure a full frame than it does a frame with only 2-3 grains in it. Therefore, less frames of the concentrate material are measured in the three hours assigned to each sample.

Julie Melluish
Julie Melluish
Mineralogist

JM/mb/MINRE

TABLE 1: The Twenty Two Concentrates Analyzed for this Report. The Equivalent RPC Number is Also Listed.

Sample		RPC #
Float Concentrate:	Feb. 16-20	6842A
	Feb. 23-27	6842B
	Mar. 02-06	6842C
	Mar. 09-13	6842D
	Apr. 06-10	6842E
	May 19-22	6842F
	May 25-28	6842G
	June 01-05	6842H
	June 08-12	6842I
	June 15-19	6842J
	June 22-26	6842K
OK Concentrate:	Feb. 16-20	6843A
	Feb. 23-27	6843B
	Mar. 02-06	6843C
	Mar. 09-13	6843D
	Apr. 06-10	6843E
	May 19-22	6843F
	May 25-28	6843G
	June 01-05	6843H
	June 08-12	6843I
	June 15-19	6843J
	June 22-26	6843K

TABLE 2: Mineral Distribution Based on Area, Weighted Area and Number of Grains (Frequency) for the Float Concentrate Samples (#6842)

Sample	Distribution Based on Area (in %)				Distribution Based on Weighted Area (in %)				Distribution Based on Frequency (in %)			
	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite
6842A, Feb. 16-20	1.91	92.80	4.99	0.27	2.72	91.99	4.94	0.35	3.68	79.81	12.17	4.34
6842B, Feb. 23-27	1.89	92.80	4.40	0.96	2.69	91.72	4.34	1.25	1.87	80.42	10.38	7.32
6842C, Mar. 02-06	2.70	93.01	4.05	0.24	3.84	91.86	3.99	0.31	3.52	85.08	9.33	2.07
6842D, Mar. 09-13	1.91	95.93	2.02	0.14	2.72	95.10	2.00	0.18	4.79	86.52	7.61	1.08
6842E, Apr. 06-10	1.52	95.62	2.77	0.08	2.17	94.98	2.75	0.10	3.77	87.91	7.54	0.77
6842F, May 19-22	1.97	95.11	2.36	0.57	2.80	94.12	2.33	0.74	0.47	87.73	7.84	3.96
6842G, May 25-28	2.58	93.52	3.07	0.83	3.66	92.24	3.02	1.08	4.88	82.26	8.96	3.90
6842H, June 01-05	1.55	94.94	3.09	0.42	2.21	94.18	3.06	0.55	4.29	82.66	10.29	2.76
6842I, June 08-12	2.18	92.81	4.34	0.68	3.10	91.73	4.28	0.89	2.91	75.62	16.72	4.75
6842J, June 15-19	1.70	95.20	2.87	0.23	2.43	94.43	2.84	0.30	3.01	83.16	11.83	2.00
6842K, June 22-26	0.97	95.64	2.92	0.48	1.39	95.09	2.90	0.63	1.97	87.34	8.63	2.05

TABLE 3: Mineral Distribution Based on Area, Weighted Area and Number of Grains (Frequency) for the Concentrate Samples (#6843) O.K CELL

Sample	Distribution Based on Area (in %)				Distribution Based on Weighted Area (in %)				Distribution Based on Frequency (in %)			
	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite
6843A, Feb. 16-20	1.50	93.71	3.75	1.03	2.14	92.81	3.71	1.34	1.92	85.64	7.81	4.62
6843B, Feb. 23-27	0.98	95.16	3.23	0.63	1.40	94.57	3.20	0.83	1.19	92.35	4.64	1.81
6843C, Mar. 02-06	2.41	93.77	3.47	0.35	3.43	92.69	3.42	0.46	1.61	85.33	8.17	4.89
6843D, Mar. 09-13	0.61	97.18	1.91	0.30	0.87	96.83	1.90	0.39	2.08	92.27	4.53	1.12
6843E, Apr. 06-10	3.76	81.34	13.87	1.03	5.30	79.79	13.58	1.33	2.91	78.53	13.83	4.74
6843F, May 19-22	0.43	98.45	0.98	0.14	0.62	98.22	0.98	0.18	3.39	91.99	3.39	1.23
6843G, May 25-28	0.85	97.11	1.36	0.68	1.22	96.54	1.35	0.89	1.28	87.07	6.69	4.96
6843H, June 01-05	0.33	96.67	2.46	0.54	0.47	96.37	2.45	0.71	0.96	92.70	3.77	2.57
6843I, June 08-12	2.68	94.94	1.75	0.63	3.80	93.66	1.72	0.82	2.44	86.49	7.69	3.38
6843J, June 15-19	1.92	95.88	2.00	0.20	2.74	95.02	1.98	0.26	2.61	89.68	5.61	2.10
6843K, June 22-26	0.70	97.70	1.30	0.30	1.00	97.31	1.29	0.39	2.53	75.62	14.03	7.82

APPENDIX A-1

Graphical Representations of the Mineral Distribution Data Based on Surface Area.

FIGURE 1: Graphical Representations of the Mineral Distribution Data Based on Surface Area for Float Concentrates.

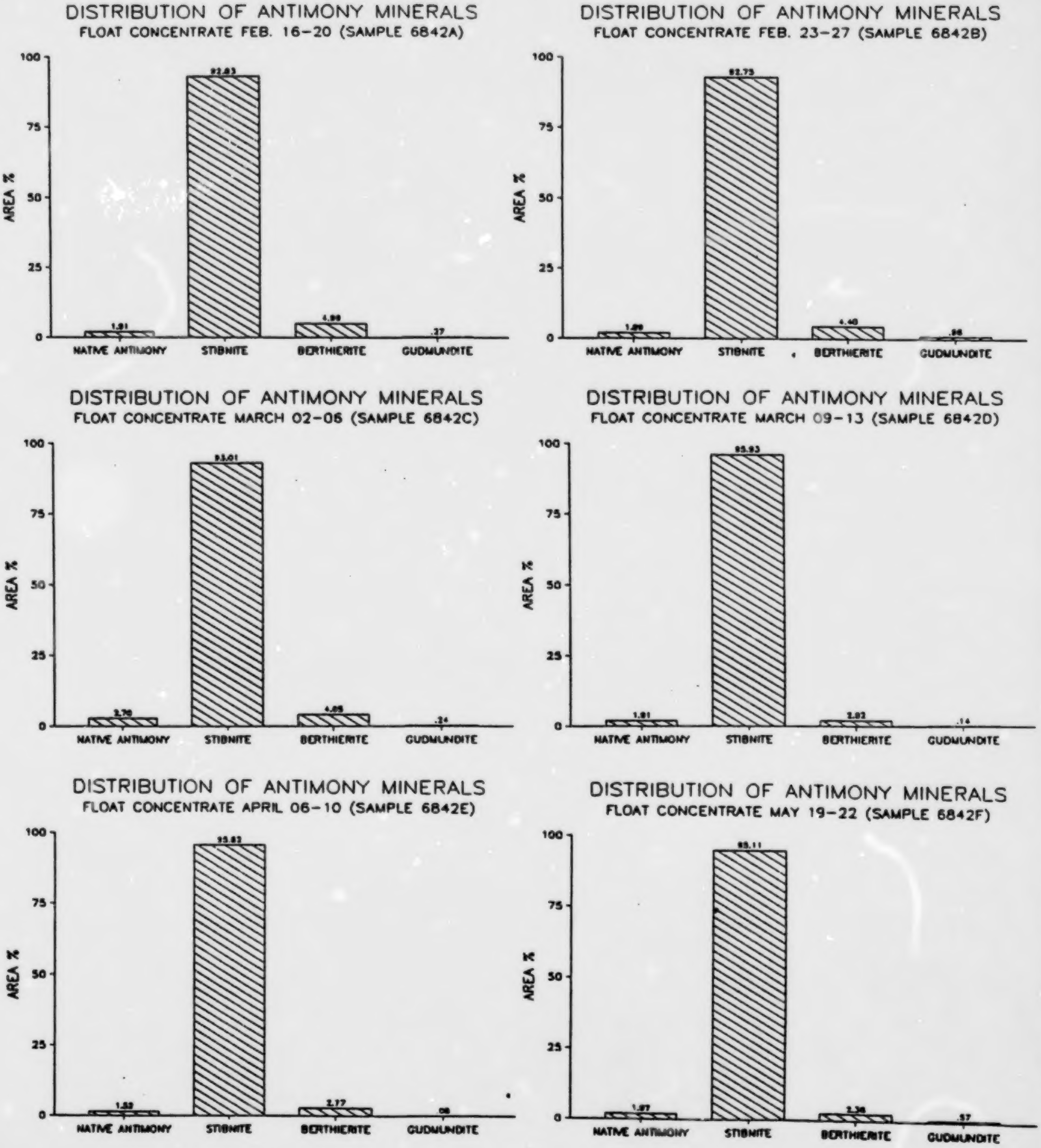
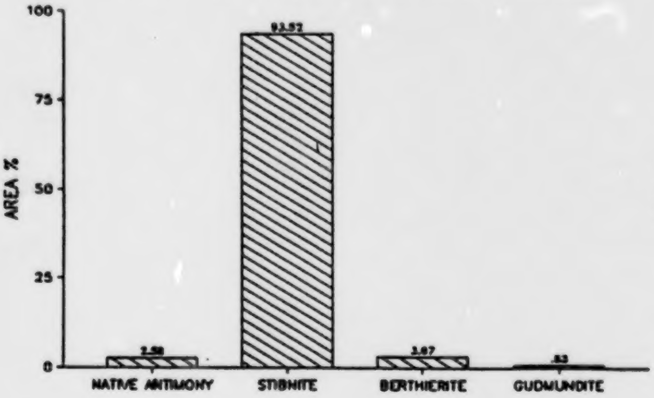
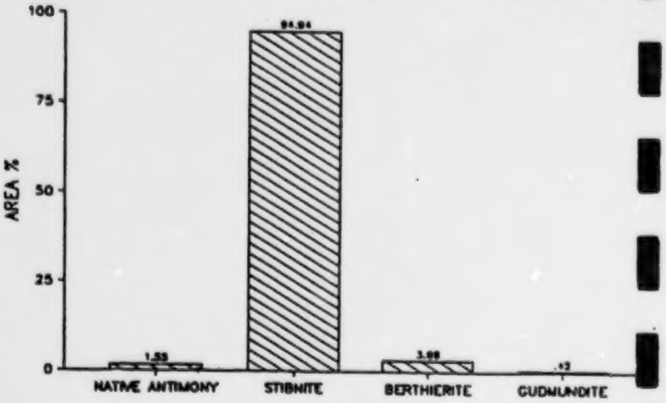


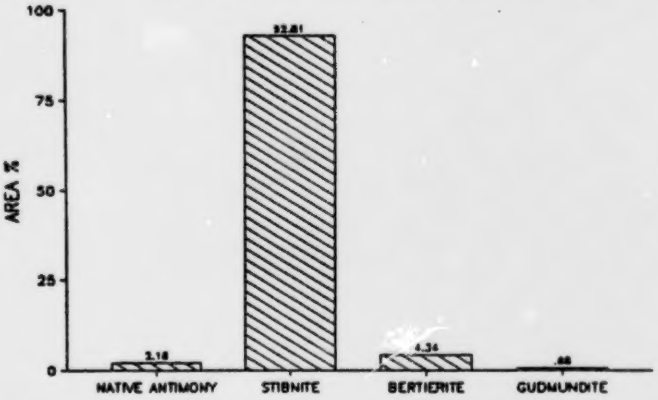
FIGURE 1: (Cont'd)



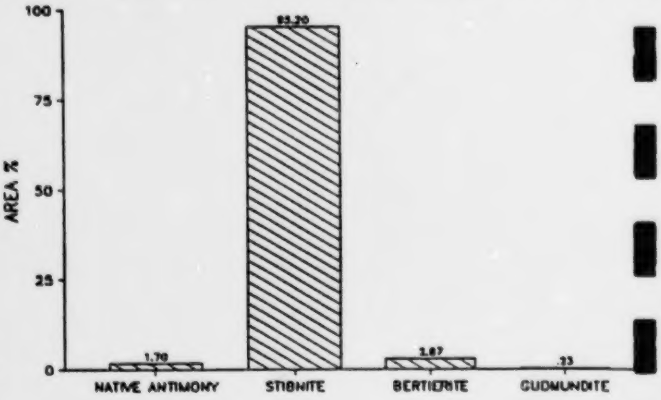
DISTRIBUTION OF ANTIMONY MINERALS
FLOAT CONCENTRATE MAY 25-28 (SAMPLE 6842G)



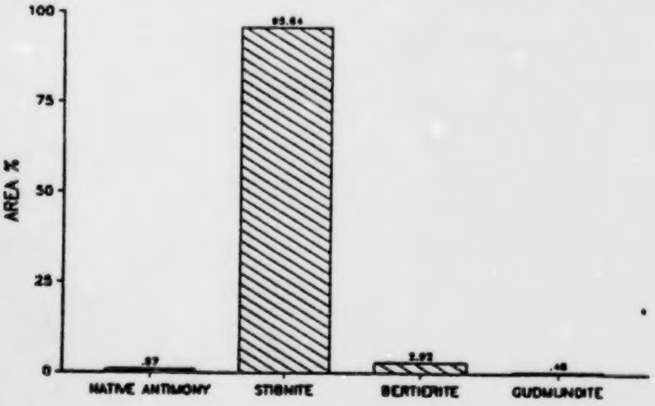
DISTRIBUTION OF ANTIMONY MINERALS
FLOAT CONCENTRATE JUNE 01-05 (SAMPLE 6842H)



DISTRIBUTION OF ANTIMONY MINERALS
FLOAT CONCENTRATE JUNE 08-12 (SAMPLE 6842I)



DISTRIBUTION OF ANTIMONY MINERALS
FLOAT CONCENTRATE JUNE 15-19 (SAMPLE 6842J)



DISTRIBUTION OF ANTIMONY MINERALS
FLOAT CONCENTRATE JUNE 22-26 (SAMPLE 6842K)

FIGURE 2: Graphical Representation of the Mineral Distribution Data Based on Surface Area for OK Concentrates.

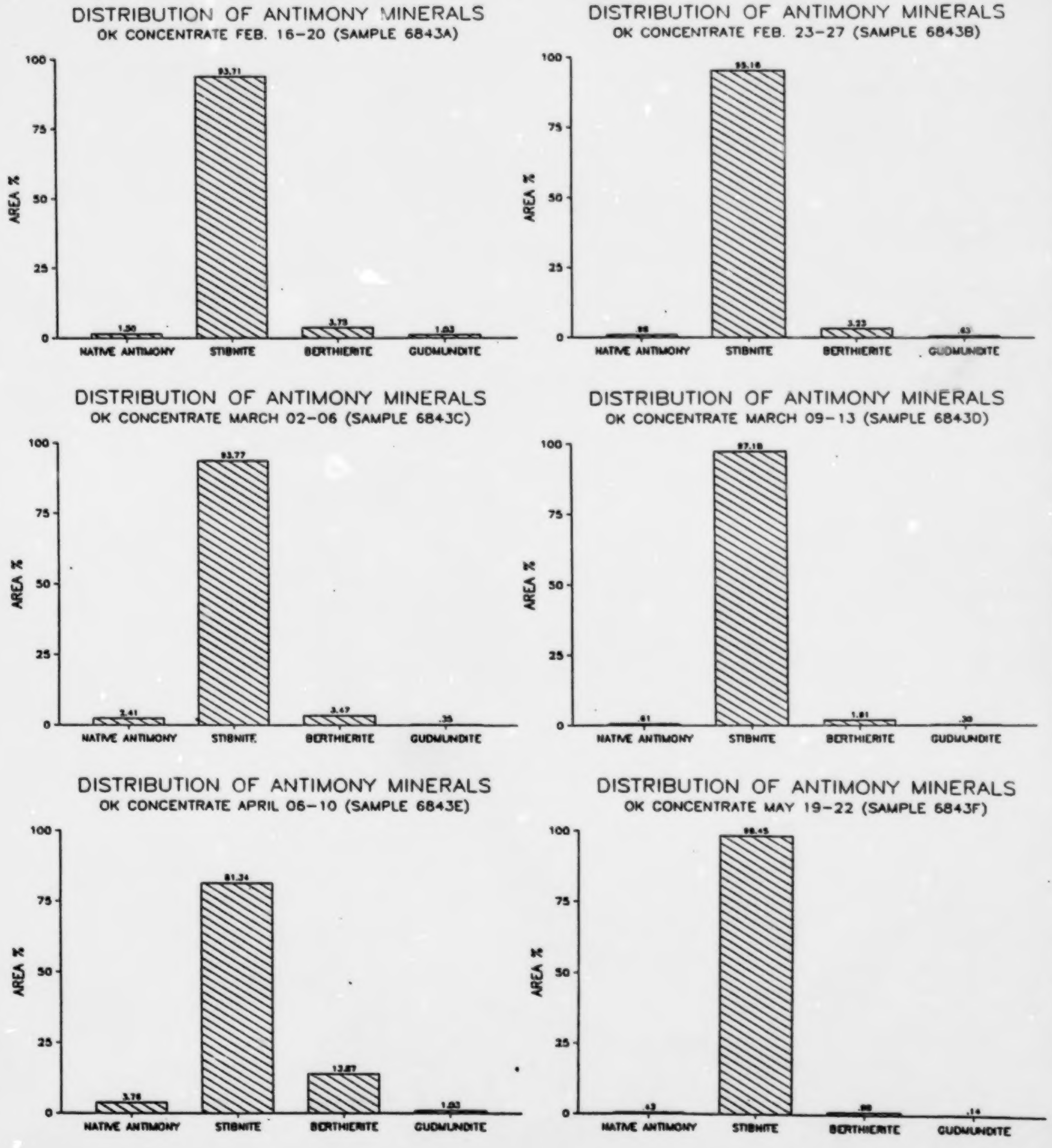
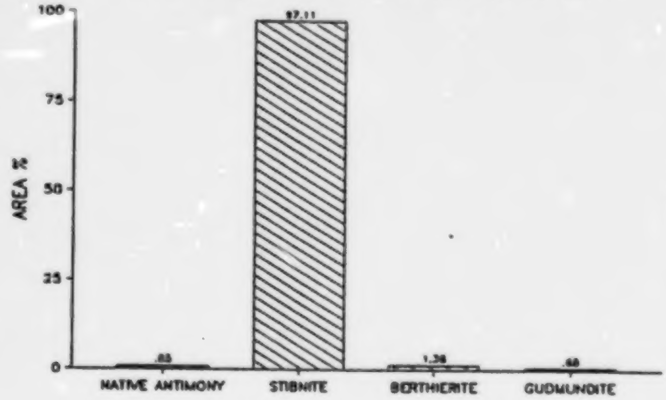
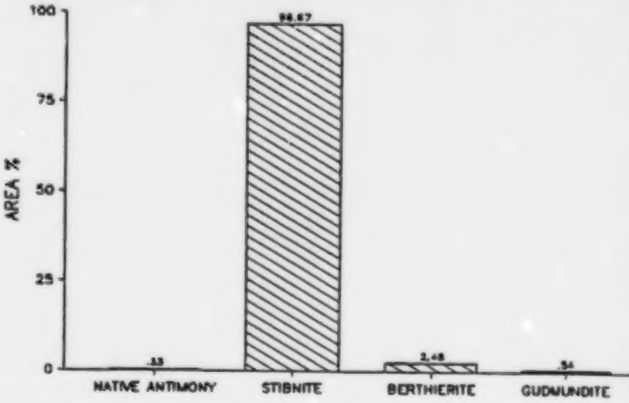


FIGURE 2: (Cont'd)


DISTRIBUTION OF ANTIMONY MINERALS
OK CONCENTRATE MAY 25-28 (SAMPLE 6843G)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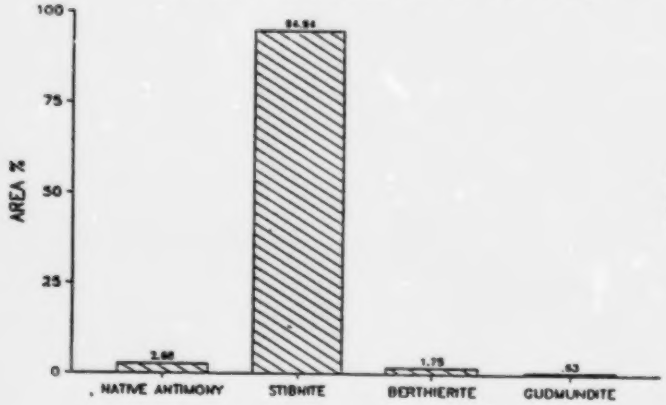
OK CONCENTRATE JUNE 01-05 (SAMPLE 6843H)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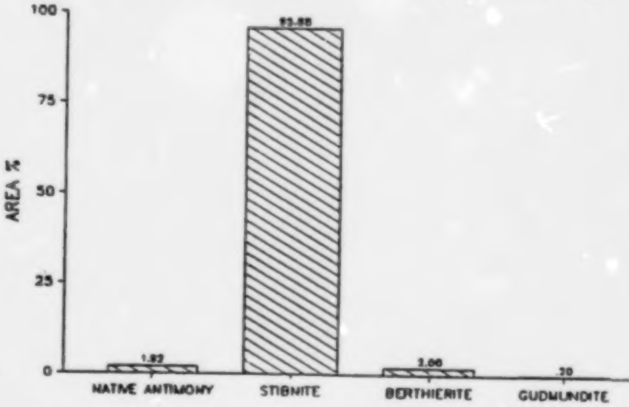
OK CONCENTRATE JUNE 08-12 (SAMPLE 6843I)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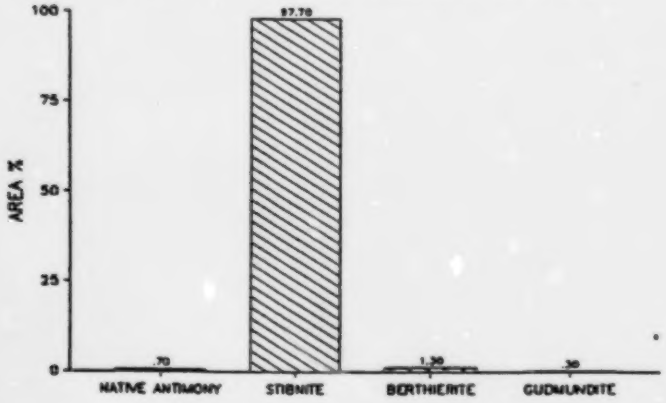
OK CONCENTRATE JUNE 15-19 (SAMPLE 6843J)


DISTRIBUTION OF ANTIMONY MINERALS
OK CONCENTRATE JUNE 22-26 (SAMPLE 6843K)

APPENDIX A-2

Calculations for the Mineral
Distribution Data Based on
Weighted Area.

TABLE 4: AREA % AND WEIGHT % DISTRIBUTIONS FOR THE FLOAT CONCENTRATE SAMPLES. THE SPECIFIC GRAVITY VALUES USED FOR THE WEIGHT % DISTRIBUTIONS ARE AS FOLLOWS: NATIVE ANTIMONY 6.688, STIBNITE AND BERTHIERITE 4.65, AND GUDMUNDITE 6.13. SAMPLE CALCULATION FOR NATIVE ANTIMONY IN SAMPLE 6842A ARE AS FOLLOWS:

AREA% x S.G. = WEIGHTED AREA% (WTED AREA%)
2.33 x 6.688 = 15.58

(WTED AREA% ÷ TOTAL WTED AREA%) x 100 = WEIGHT %
(15.58 ÷ 470.56) x 100 = 3.31

	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)
SAMPLE:	6842A			6842B			6842C		
NATIVE ANTIMONY	1.91	12.77	2.72	1.89	12.64	2.69	2.7	18.06	3.84
STIBNITE	92.80	431.52	91.99	92.80	431.52	91.72	93.01	432.50	91.86
BERTHIERITE	4.99	23.15	4.94	4.40	20.42	4.34	4.05	18.79	3.99
GUDMUNDITE	.27	1.66	.35	.96	5.88	1.25	.24	1.47	.31
TOTAL		469.10			470.46			470.82	
SAMPLE:	6842D			6842E			6842F		
NATIVE ANTIMONY	1.91	12.77	2.72	1.52	10.17	2.17	1.97	13.18	2.80
STIBNITE	95.93	446.07	95.10	95.62	444.63	94.98	95.11	442.26	94.12
BERTHIERITE	2.02	9.37	2.00	2.77	12.85	2.75	2.36	10.95	2.33
GUDMUNDITE	.14	.86	.18	.08	.49	.10	.57	3.49	.74
TOTAL		469.08			468.14			469.88	
SAMPLE:	6842G			6842H			6842I		
NATIVE ANTIMONY	2.58	17.26	3.66	1.55	10.37	2.21	2.18	14.58	3.10
STIBNITE	93.52	434.87	92.24	94.94	441.47	94.18	92.81	431.57	91.73
BERTHIERITE	3.07	14.24	3.02	3.09	14.34	3.06	4.34	20.14	4.28
GUDMUNDITE	.83	5.09	1.08	.42	2.57	.55	.68	4.17	.89
TOTAL		471.46			468.75			470.45	
SAMPLE:	6842J			6842K					
NATIVE ANTIMONY	1.70	11.37	2.43	.97	6.49	1.39			
STIBNITE	95.20	442.68	94.43	95.64	444.73	95.09			
BERTHIERITE	2.87	13.32	2.84	2.92	13.55	2.90			
GUDMUNDITE	.23	1.41	.30	.48	2.94	.63			
TOTAL		468.78			467.70				

TABLE 5: AREA % AND WEIGHT % DISTRIBUTIONS FOR THE 0K CONCENTRATE SAMPLES. THE SPECIFIC GRAVITY VALUES USED FOR THE WEIGHT % DISTRIBUTIONS ARE AS FOLLOWS: NATIVE ANTIMONY 6.688, STIBNITE AND BERTHIERITE 4.65, AND GUDMUNDITE 6.13. SAMPLE CALCULATION FOR NATIVE ANTIMONY IN SAMPLE 6842A ARE AS FOLLOWS:

AREA% x S.G. = WEIGHTED AREA% (WTED AREA%)
2.33 x 6.688 = 15.58

(WTED AREA% ÷ TOTAL WTED AREA%) x 100 = WEIGHT %
(15.58 ÷ 470.56) x 100 = 3.31

	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)
SAMPLE:	6843A			6843B			6843C		
NATIVE ANTIMONY	1.50	10.03	2.14	.98	6.55	1.40	2.41	16.12	3.43
STIBNITE	93.71	435.75	92.81	95.16	442.49	94.57	93.77	436.03	92.69
BERTHIERITE	3.75	17.40	3.71	3.23	14.99	3.20	3.47	16.10	3.42
GUDMUNDITE	1.03	6.31	1.34	.63	3.86	.83	.35	2.15	.46
TOTAL		469.50			467.90			470.39	
SAMPLE:	6843D			6843E			6843F		
NATIVE ANTIMONY	.61	4.08	.87	3.76	25.15	5.30	.43	2.88	.62
STIBNITE	97.18	451.89	96.83	81.34	378.23	79.79	98.45	457.79	98.22
BERTHIERITE	1.91	8.88	1.90	13.87	64.36	13.58	.98	4.55	.98
GUDMUNDITE	.30	1.84	.39	1.03	6.31	1.33	.14	.86	.18
TOTAL		466.67			474.05			466.07	
SAMPLE:	6843G			6843H			6843I		
NATIVE ANTIMONY	.85	5.68	1.22	.33	2.21	.47	2.68	17.92	3.80
STIBNITE	97.11	451.56	96.54	96.67	449.52	96.37	94.94	441.47	93.66
BERTHIERITE	1.36	6.31	1.35	2.46	11.41	2.45	1.75	8.12	1.72
GUDMUNDITE	.68	4.17	.89	.54	3.31	.71	.63	3.86	.82
TOTAL		467.73			466.45			471.38	
SAMPLE:	6843J			6843K					
NATIVE ANTIMONY	1.92	12.84	2.74	.70	4.68	1.00			
STIBNITE	95.88	445.84	95.02	97.70	454.31	97.31			
BERTHIERITE	2.00	9.28	1.98	1.30	6.03	1.29			
GUDMUNDITE	.20	1.23	.26	.30	1.84	.39			
TOTAL		469.19			466.06				

APPENDIX A-3

Calculations for the Mineral Distribution Data Based on Frequency.

TABLE 7: THE NUMBER OF GRAINS COUNTED IN THE MINERAL DISTRIBUTION STUDIES OF THE OK CONCENTRATE SAMPLES.

	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)
SAMPLE:	6843A		6843B		6843C		6843D	
NATIVE ANTIMONY	256	1.92	212	1.19	166	1.61	596	2.08
STIBNITE	11400	85.64	16400	92.35	8780	85.33	26500	92.27
BERTHIERITE	1040	7.81	824	4.64	841	8.17	1300	4.53
GUDMUNDITE	615	4.62	322	1.81	503	4.89	323	1.12
TOTAL	13311		17758		10290		28719	
# OF FRAMES	182		185		170		170	
SAMPLE:	6843E		6843F		6843G		6843H	
NATIVE ANTIMONY	681	2.91	766	3.39	317	1.28	217	.96
STIBNITE	18400	78.53	20800	91.99	21600	87.07	21000	92.70
BERTHIERITE	3240	13.83	767	3.39	1660	6.69	853	3.77
GUDMUNDITE	1110	4.74	279	1.23	1230	4.96	583	2.57
TOTAL	23431		22612		24807		22653	
# OF FRAMES	190		170		180		184	
SAMPLE:	6843I		6843J		6843K			
NATIVE ANTIMONY	536	2.44	1090	2.61	486	2.53		
STIBNITE	19000	86.49	37400	89.68	14500	75.62		
BERTHIERITE	1690	7.69	2340	5.61	2690	14.03		
GUDMUNDITE	742	3,38	874	2.10	1500	7.82		
TOTAL	21968		41704		19176			
# OF FRAMES	193		190		170			

TABLE 6: THE NUMBER OF GRAINS COUNTED IN THE MINERAL DISTRIBUTION STUDIES OF THE FLOAT CONCENTRATE SAMPLES.

	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)
SAMPLE:	6842A		6842B		6842C		6842D	
NATIVE ANTIMONY	951	3.68	417	1.87	1073	3.52	1340	4.79
STIBNITE	20600	79.81	17900	80.42	25900	85.08	24200	86.52
BERTHIERITE	3140	12.17	2310	10.38	2840	9.33	2130	7.61
GUDMUNDITE	1120	4.34	1630	7.32	630	2.07	302	1.08
TOTAL	25811		22257		30443		27972	
# OF FRAMES	179		151		177		180	
SAMPLE:	6842E		6842F		6842G		6842H	
NATIVE ANTIMONY	1210	3.77	120	.47	1400	4.88	1250	4.29
STIBNITE	28200	87.91	22600	87.73	23600	82.26	24100	82.66
BERTHIERITE	2420	7.54	2020	7.84	2570	8.96	3000	10.29
GUDMUNDITE	247	.77	1020	3.96	1120	3.90	804	2.76
TOTAL	32077		25760		28690		29154	
# OF FRAMES	170		175		170		170	
SAMPLE:	6842I		6842J		6842K			
NATIVE ANTIMONY	766	2.91	772	3.01	593	1.97		
STIBNITE	19900	75.62	21300	83.16	26300	87.34		
BERTHIERITE	4400	16.72	3030	11.83	2600	8.63		
GUDMUNDITE	1250	4.75	511	2.00	618	2.05		
TOTAL	26316		25613		30111			

APPENDIX A.05

MINERALOGICAL REPORT M/87/032

O.C. and min.

DATE: November 2, 1987
MINERALOGICAL REPORT: M/87/032
JOB NUMBER: 08200035/0004
SUBMITTED BY: Durham Resources Inc.
Prince William, N. B.
E0H 1S0
Attn: Victor Hendricken

Thirty-four samples were submitted to RPC on September 4th, 1987, for analysis. This report contains the results for the twelve samples not discussed in the previous report (RPC Mineralogical Report #M/87/028). Table 1 lists these samples.

The JEOL 733 electron microprobe interfaced with the KONTRON automated image analyzer was used to determine the distribution of the antimony phases -- native antimony, stibnite, berthierite and gudmundite. Tables 2 and 3 contain the mineral distribution data based on surface area, weighted surface area, and frequency (number of individual grains). Appendix A-1 contains the graphical representations of the distribution data based on surface area. In Appendices A-2 and A-3 calculations are shown for the weighted area distributions and the frequency distributions, respectively.

Liberation and association of the various antimony phases in the Sc Slimes Concentrate and the Final Tailings was also determined using the microprobe and image analyzer. Tables 5 to 7 and 12 to 14 contain summaries of the results. These tables list the following:

(a) the phase combinations observed
(b) the amount of each combination observed, in counts (number of whole particles) and percent of total surface area measured
(c) the amount of liberated material expressed in the same way as above
(d) the distribution of the locked material as a percent of the whole grain expressed in the same way as above

TABLE 1: The Twelve Samples Analyzed for the Report. The equivalent RPC numbers are included in the list.

Sample		RPC #
OK Concentrate	-25 micron	6838A
	+25 micron	6838B
	+75 micron	6838C
Cleaner Concentrate	-25 micron	6839A
	+25 micron	6839B
	+75 micron	6839C
Sc Slimes Concentrate	-25 micron	6840A
	+25 micron	6840B
	+75 micron	6840C
Final Tailings	-25 micron	6841A
	+25 micron	6841B
	+75 micron	6841C

(e) and, the average size of the individual grains of each phase (note that numerous individual grains can occur in one whole particle) expressed as the average surface area and the square root of that value (in square microns and microns, respectively). Note that the square root value gives a best estimate of the average sieve size of the individual grains.

(f) and, in the two-mineral phase combinations, the percent berthierite, native or stibnite (based on surface area) instead of the average size values.

Appendix A-5 contains details of the liberation data in Tables 5 to 7 and 12 to 14.

The results of the association study indicate that all the antimony phases generally occur separately in various liberation states. Only sixteen poly-mineralic phase combinations were observed, most of which occur in the Sc Slimes Concentrate samples. Berthierite with stibnite or native antimony are the most common combinations. The amount of berthierite relative to the other antimony phases varies greatly as does the habit of the berthierite. It occurs as coarse intergrowths, small equant to semi-equant inclusions, and sometimes acicular inclusions and intergrowths. The berthierite present as a mono-mineralic phase combination also exhibits these habits. The remaining antimony phases occur predominantly as equant to semi-equant inclusions or coarse intergrowths. Native antimony does also occur as blebby inclusions and stibnite rarely occurs as acicular inclusions. Gudmundite generally occurs as liberated particles.

Finally, it was noted that the +25 and +75 micron size fractions in the Sc Slimes Concentrate contain abundant (approximately 50% of samples) fine-grained material which appears to have clumped together and remained in the larger size fractions. The clumped material was noted as such during the liberation study and approximate distributions have been determined based on this. Table 4 contains the distributions of clumped and non-clumped antimony grains for both size fractions.

Appendix A-1 contains the graphical representations of the surface area based distributions of these samples and Appendices A-2 and A-3 contain calculations for the weighted area and frequency distributions, respectively. Tables 8 to 11 contain the phase combination, liberation and average size data for the clumped and non-clumped portions of the two size fractions.

Julie Melluish

Julie Melluish
Mineralogist

JM/mb/MINRE2

TABLE 2: Mineral Distribution Based on Surface Area, Weighted Area, and Number of Grains (Frequency) for the Concentrate (July 14, 6838) and Concentrate (July 14, 6839) Samples.

Sample	Distribution Based on Area (in %)				Distribution Based on Weighted Area (in %)				Distribution Based on Frequency (in %)			
	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite
6838A, −25 micron	2.40	96.30	1.08	0.19	3.41	95.27	1.07	0.25	2.00	95.15	2.22	0.63
6838B, +25 micron	2.65	95.90	1.38	0.11	3.77	94.73	1.36	0.14	3.58	91.10	4.59	0.73
6838C, +75 micron	0.97	97.80	1.15	0.12	1.39	97.31	1.14	0.16	4.01	88.06	6.47	1.46
6839A ~~6838A~~, −25 micron	2.37	95.10	2.19	0.34	3.37	94.03	2.16	0.44	1.33	93.07	4.37	1.23
[illegible] ~~6838B~~, +25 micron	1.17	95.70	2.90	0.19	1.67	95.20	2.88	0.25	3.24	88.39	7.19	1.17
[illegible] 6838C, +75 micron	0.59	97.50	1.87	0.09	1.85	97.18	1.86	0.12	3.30	87.50	7.58	1.62

TABLE 3: Mineral Distribution Based on Surface Area, Weighted Area, and Number of Grains (Frequency) for the Sc Slime Conc. (Sample 6840) and the Tailings (Sample 6841).

Sample	Distribution Based on Area (in %)				Distribution Based on Weighted Area (in %)				Distribution Based on Frequency (in %)			
	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite
6840A, -25 micron	14.03	12.11	67.84	6.01	18.70	11.22	62.73	7.35	5.27	17.63	68.37	8.73
6840B, +25 micron	20.39	10.67	63.20	5.74	26.51	9.64	57.01	6.84	10.27	18.32	59.65	11.77
6840C, +75 micron	6.57	62.91	26.21	4.31	9.07	60.38	25.10	5.45	7.03	30.11	44.27	18.59
6841A, -25 micron	0.07	19.45	60.69	19.79	0.09	18.31	57.02	24.57	0.44	15.33	55.91	28.32
6841B, +25 micron	4.12	5.58	77.43	12.87	5.60	5.28	16.05	16.05	6.42	13.55	64.05	15.98
6841C, +75 micron	5.75	62.87	25.45	7.93	7.93	60.26	24.34 6.81	7.48 6.81	8.74	21.19 52.79	51.49 30.27	18.59 11.17

TABLE 4: Mineral Distribution Based on Surface Area, Weighted Area, and Number of Grains (Frequency) for the Sc Slime Conc. Samples (6840B/C) Separated into Clumped and Non-clumped Particles.

Sample	Distribution Based on Area (in %)				Distribution Based on Weighted Area (in %)				Distribution Based on Frequency (in %)			
	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite	Native Sb	Stibnite	Berthierite	Gudmundite
6840B, -25 micron (Non-clumped)	15.73	9.9	63.45	10.92	20.52	8.98	57.44	13.06	27.35	13.68	50.43	8.55
6840B, +25 micron (Clumped)	2.92	4.97	87.23	4.88	4.09	4.84	84.80	6.27	2.82	4.58	88.73	3.87
6840C, +75 micron (Non-clumped)	0.26	99.30	0.44	0	0.37	99.19	0.44	0	33.09	36.03	30.88	0
6840C, +75 micron (Clumped)	18.04	31.65	42.27	7.84	23.56	28.74	38.31	9.39	7.37	16.67	72.44	3.53

TABLE 5: The Various Phase Combinations and Their Liberation State in the Sc Slimes Conc., -25 micron (Sample 6840A). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

Phase Combination	Distribution Counts, area	Liberated counts, area	Non-liberated by counts (area %) <10%	10-25%	25-50%	50-75%	75-95%	Average Grain Size
Berthierite	193 65.57	193 65.57	—	—	—	—	—	7.42 2.72
Berthierite/ Native Sb	1 3.40	— —	—	—	—	—	1 (3.40)	N/A 2.6% B
Stibnite	46 14.36	46 14.36	—	—	—	—	—	6.82 2.61
Native Sb	10 8.71	10 8.71	—	—	—	—	—	19.02 4.36
Gudmundite	10 7.95	10 7.95	—	—	—	—	—	17.35 4.17

TABLE 6: The Various Phase Combinations and Their Liberation State in the Sc Slimes Conc., +25 micron (Sample 6840B). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

Phase	Distribution		Liberated		Non-liberated by counts (area %)					Average
Combination	Counts,	area	counts,	area	<10%	10-25%	25-50%	50-75%	75-95%	Grain Size
Berthierite	292	66.86	285	58.04	1(0.03)	2(1.25)	1(5.93)	3(1.61)	—	64.45 8.03
Berthierite/ Native Sb	1	1.50	--	--	--	--	1(1.50)	--	--	N/A 24.3% B
Berthierite/ Stibnite	1	2.46	—	--	—	--	--	--	1(2.46)	N/A 82.4% B
Stibnite	21	8.26	19	7.77	2(0.50)	--	--	--	--	96.86 9.84
Native Sb	22	11.16	12	6.29	2(0.14)	2(0.50)	4(1.87)	1(0.52)	1(1.84)	136.24 11.67

TABLE 6 (Cont'd)

Gudmundite	18	7.41	16	7.17	1(0.06)	1(0.18)	—	—	—	108.59 10.42
Native Sb/ Gudmundite	1	2.35	—	—	—	—	—	—	1(2.35)	N/A 86.8% N

TABLE 7: The Various Phase Combinations and Their Liberation State in the Sc Slimes Conc., +75 micron (Sample 6840C). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

Phase Combination	Distribution Counts, area		Liberated counts, area		Non-liberated by counts (area %)					Average Grain Size
					<10%	10-25%	25-50%	50-75%	75-95%	
Berthierite	219	1.22	214	1.01	2 (0.02)	2 (0.08)	1 (0.12)	—	—	31.80 5.64
Berthierite/ Native Sb	4	(0.14)	—	--	1 (0.01)	3 (0.13)	--	—	--	N/A 49.4% B
Berthierite/ Stibnite	3	0.16	2	0.03	—	1 (0.13)	--	—	—	N/A 17.5% B
Berthierite/ Gudmundite	2	0.01	--	--	2 (0.01)	--	--	—	—	N/A 44.1% B

TABLE 7 (Cont'd)

Stibnite	69	1.85	44	0.69	18 (0.52)	5 (0.54)	1 (0.03)	1 (0.08)	—	121.45 11.02
Stibnite/ Native Sb	1	96.06	1	96.06	—	—	—	—	—	N/A 99.8% S
Native Sb	22	0.40	18	0.27	2 (0.03)	1 (0.04)	—	—	1 (0.05)	102.13 10.11
Gudmundite	9	0.16	9	0.16	—	—	—	—	—	109.69 10.47

TABLE 8: The Various Phase Combinations and Their Liberation State in the Sc Slimes Conc. (Non-Clumped), +25 micron (Sample 6840B). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

Phase Combination	Distribution Counts, area		Liberated counts, area		Non-liberated by counts (area %)					Average Grain Size
					<10%	10-25%	25-50%	50-75%	75-95%	
Berthierite	40	60.28	33	48.82	1(0.04)	2(1.65)	1(7.84)	3(2.12)	—	256.84 16.03
Berthierite/ Native Sb	1	1.99	—	—	—	—	1(1.99)	—	—	N/A 24.3% B
Berthierite/ Stibnite	1	3.25	—	—	—	—	—	—	1(3.25)	N/A 82.4% B
Stibnite	8	9.33	6	8.67	2(0.66)	—	—	—	—	172.19 13.12

TABLE 8 (Cont'd.)

Native Sb	14	13.82	4	7.37	2 (0.18)	2 (0.67)	4 (2.48)	1 (0.69)	1 (2.43)	127.55 11.29
Native Sb/ Gudmundite	1	3.11	--	--	--	--	--	--	1 (3.11)	N/A 86.8% N
Gudmundite	7	8.23	5	7.91	1 (0.08)	1 (0.24)	--	--	--	202.50 14.23

TABLE 9: The Various Phase Combinations and Their Liberation State in the Sc Slimes Conc. (Clumped), +25 micron (Sample 6840B). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

Phase Combination	Distribution Counts, area		Liberated counts, area		Non-liberated by counts (area %)					Average Grain Size
					<10%	10-25%	25-50%	50-75%	75-95%	
Berthierite	252	87.23	252	87.23	--	--	--	--	--	24.75 4.97
Stibnite	13	4.97	13	4.97	--	--	--	--	--	27.32 5.23
Native Sb	8	2.92	8	2.92	--	--	--	--	--	26.08 5.11
Gudmundite	11	4.88	11	4.88	--	--	--	--	--	31.76 5.64

TABLE 10: The Various Phase Combinations and Their Liberation State in the Sc Slimes Conc. (Non-Clumped), +75 micron (Sample 6840B). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

Phase	Distribution		Liberated		Non-liberated by counts (area %)					Average
Combination	Counts	area	counts	area	<10%	10-25%	25-50%	50-75%	75-95%	Grain Size
Berthierite	5	0.38	1	0.16	1(0.02)	2(0.08)	1(0.12)	—	—	91.64 9.57
Berthierite/ Native Sb	2	0.11	—	—	—	2(0.11)	—	—	—	N/A 47.3% B
Berthierite/ Stibnite	1	0.13	—	—	—	1(0.13)	—	—	—	N/A 4.3% B
Stibnite	23	1.21	1	0.17	16(0.47)	4(0.46)	1(0.03)	1(0.08)	—	165.93 12.88

TABLE 10 (Cont'd.)

Stibnite/ Native Sb	1	98.14	1	98.14	—	—	—	—	—	N/A 99.8%
Native Sb	2	0.04	—	--	2(0.04)	—	—	—	—	53.04 7.28

TABLE 11: The Various Phase Combinations and Their Liberation State in the Sc Slimes Conc. (Clumped), +75 micron (Sample 6840C). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

Phase Combination	Distribution Counts, area		Liberated counts, area		Non-liberated by counts (area %)					Average Grain Size
					<10%	10-25%	25-50%	50-75%	75-95%	
Berthierite	214	40.28	213	40.26	1(0.02)	--	--	--	--	24.66 4.97
Berthierite/ Stibnite	2	1.50	2	1.50	--	--	--	--	--	N/A 70.8% B
Berthierite/ Native Sb	2	1.64	--	--	1(0.50)	1(1.13)	--	--	--	N/A 41.9% B
Berthierite/ Gudmundite	2	0.55	--	--	2(0.55)	--	--	--	--	N/A 44.1% B

TABLE 11 (Cont'd.)

Stibnite	46	31.41	43	24.58	2(2.54)	1(4.29)	—	—	—	82.32 9.07
Native Sb	20	17.09	18	12.61	—	1(1.89)	—	—	1(2.59)	111.94 10.58
Gudmundite	9	7.53	9	7.53	—	—	—	—	—	109.69 10.47

TABLE 12: The Various Phase Combinations and Their Liberation State in the Final Tailings, -25 micron (Sample 6840C). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

Phase	Distribution		Liberated		Non-liberated by counts (area %)					Average
Combination	Counts,	area %	counts,	area %	<10%	10-25%	25-50%	50-75%	75-95%	Grain Size
Berthierite	121	73.40	118	73.13	2(0.13)	1(0.14)	--	--	--	14.54 3.81
Stibnite	18	12.27	18	12.27	--	--	--	--	--	16.34 4.04
Native Antimony	1	0.12	1	0.12	--	--	--	--	--	2.89 1.70
Gudmundite	19	14.21	18	11.90	--	--	--	--	1(2.31)	17.93 4.23

TABLE 13: The Various Phase Combinations and Their Liberation State in the Final Tailings, +25 micron (Sample 6841B). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

Phase Combination	Distribution Counts, area %		Liberated counts, area %		Non-liberated by counts (area %)					Average Grain Size
					<10%	10-25%	25-50%	50-75%	75-95%	
Berthierite	50	46.35	13	25.35	13 (0.89)	9 (1.69)	6 (4.39)	6 (10.98)	3 (2.90)	130.51 11.42
Berthierite/ Native Sb	1	6.05	1	6.05	--	--	--	--	--	N/A 99.7% B
Stibnite	13	3.50	1	2.70	11 (0.54)	--	1 (0.27)	--	--	49.43 7.03
Native Sb	2	2.73	1	2.72	1 (0.01)	--	--	--	--	327.28 18.09
Gudmundite	8	41.53	6	32.22	--	1 (0.01)	1 (2.61)	--	1 (6.86)	906.74 30.11

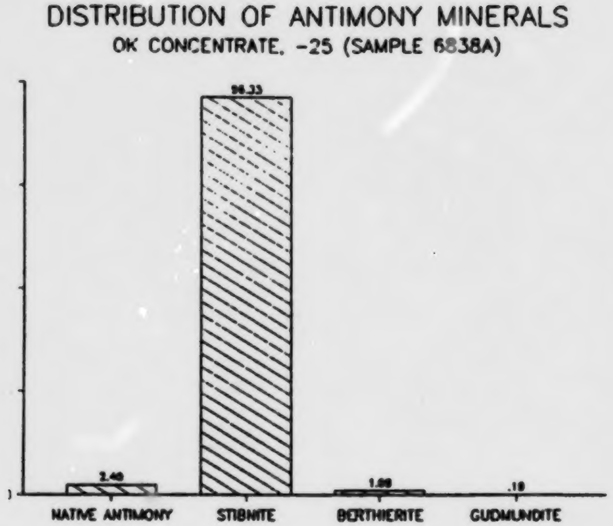
TABLE 14: The Various Phase Combinations and Their Liberation State in the Final Tailings, (Non-Clumped) +75 micron (Sample 6841C). Note area % values are based on the total surface area measured. Also, average grain sizes are based on the number of individual antimony-phase grains and counts are based on the number of whole particles and the upper grain size values. All areas are expressed in square microns. The lower grain size values are expressed in microns. (B represents Berthierite, N represents Native Antimony, and S represents Stibnite).

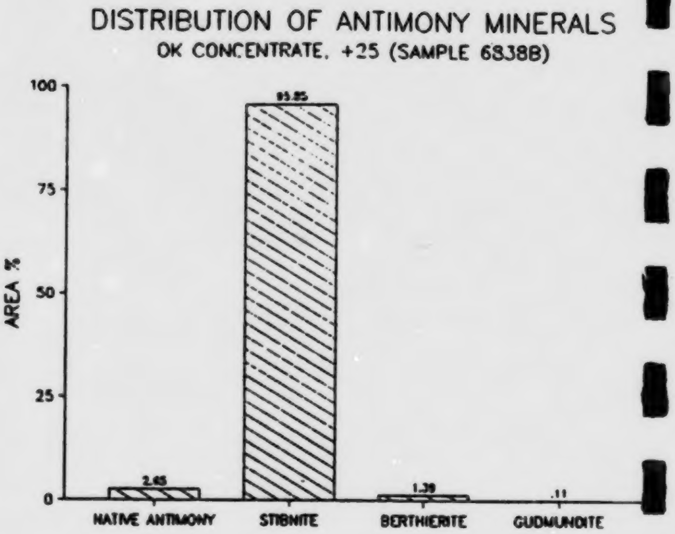
Phase	Distribution		Liberated		Non-liberated by counts (area %)					Average
Combination	Counts,	area %	counts,	area %	<10%	10-25%	25-50%	50-75%	75-95%	Grain Size
Berthierite	23	43.45	4	24.02	8 (1.66)	6 (10.53)	3 (4.37)	1 (1.48)	1 (1.40)	491.30 22.17
Stibnite	43	39.79	6	33.53	32 (2.78)	5 (3.47)	—	—	—	314.91 17.75
Stibnite/ Native Sb	1	11.29	1	11.29	—	—	—	—	—	N/A 99.6% S
Native Sb	2	5.47	1	5.44	1 (0.03)	—	—	—	—	1946.45 44.12

APPENDIX A-1

Graphical Representations of the Mineral Distribution Data Based on Surface Area

FIGURE A1.1


DISTRIBUTION OF ANTIMONY MINERALS
OK CONCENTRATE, -25 (SAMPLE 6838A)


DISTRIBUTION OF ANTIMONY MINERALS
OK CONCENTRATE, +25 (SAMPLE 6838B)

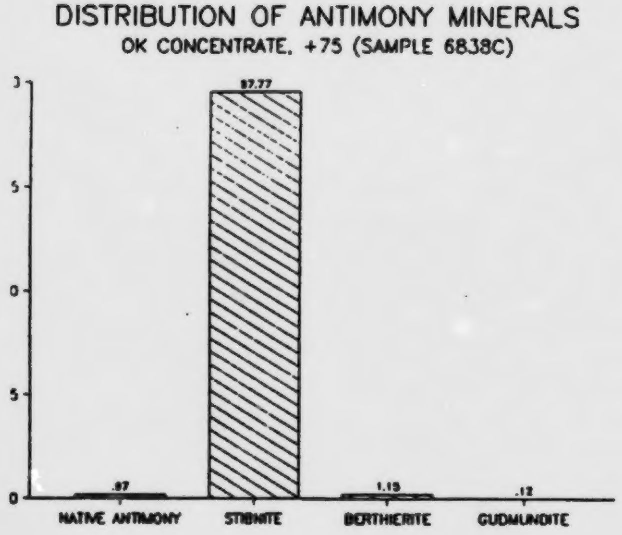
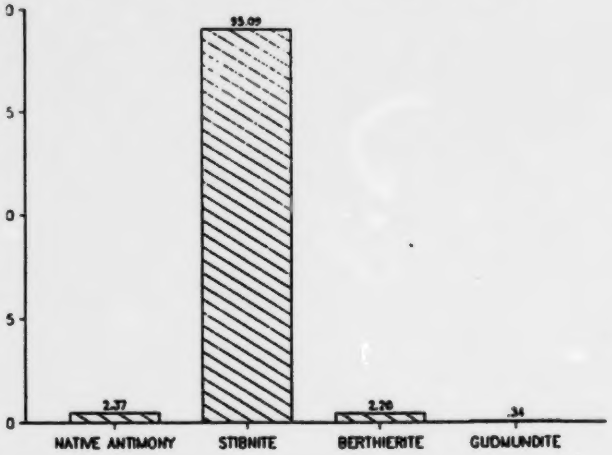
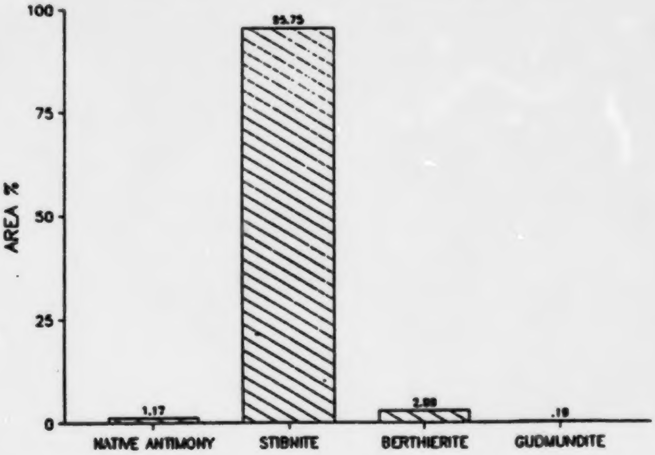

DISTRIBUTION OF ANTIMONY MINERALS
OK CONCENTRATE, +75 (SAMPLE 6838C)

FIGURE A1.2


DISTRIBUTION OF ANTIMONY MINERALS
CLEANER CONCENTRATE, −25 (SAMPLE 6839A)


DISTRIBUTION OF ANTIMONY MINERALS
CLEANER CONCENTRATE, +25 (SAMPLE 6839B)

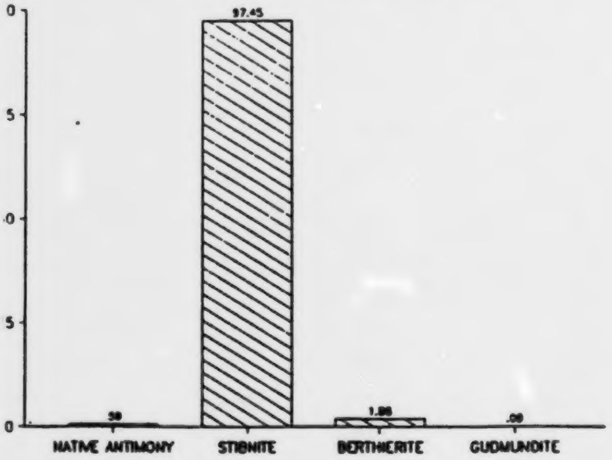
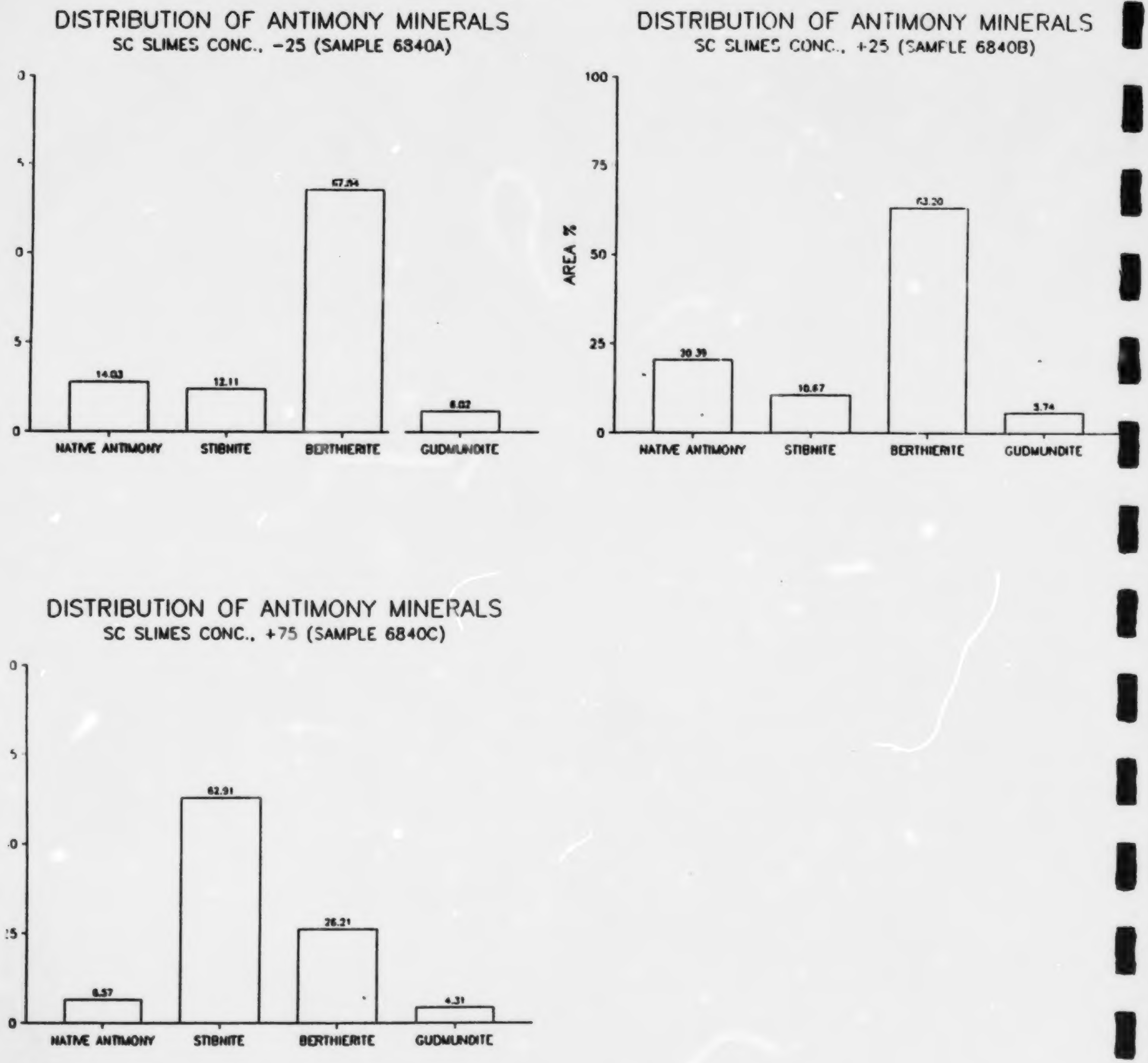

DISTRIBUTION OF ANTIMONY MINERALS
CLEANER CONCENTRATE, +75 (SAMPLE 6839C)

FIGURE A1.3

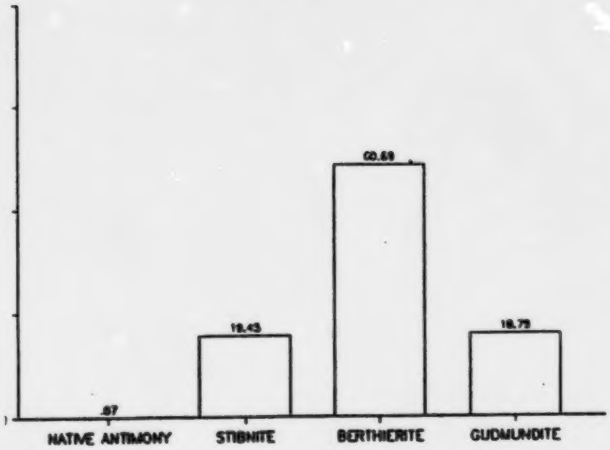


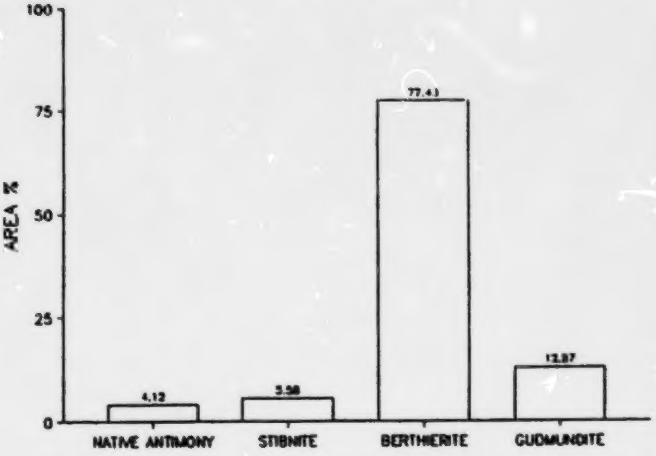
DISTRIBUTION OF ANTIMONY MINERALS
SC SLIMES CONC., -25 (SAMPLE 6840A)

DISTRIBUTION OF ANTIMONY MINERALS
SC SLIMES CONC., +25 (SAMPLE 6840B)

DISTRIBUTION OF ANTIMONY MINERALS
SC SLIMES CONC., +75 (SAMPLE 6840C)

FIGURE A1.4


DISTRIBUTION OF ANTIMONY MINERALS
FINAL TAILINGS, -25 (SAMPLE 6841A)


DISTRIBUTION OF ANTIMONY MINERALS
FINAL TAILINGS, +25 (SAMPLE 6841B)

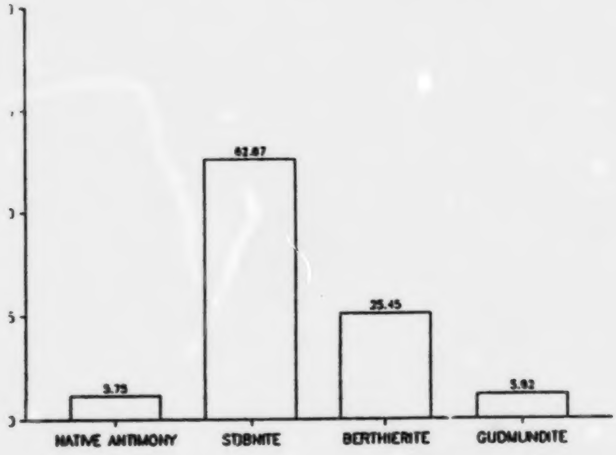
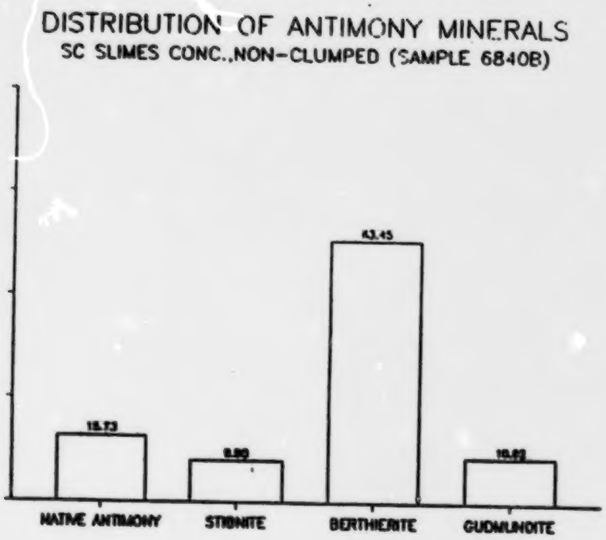
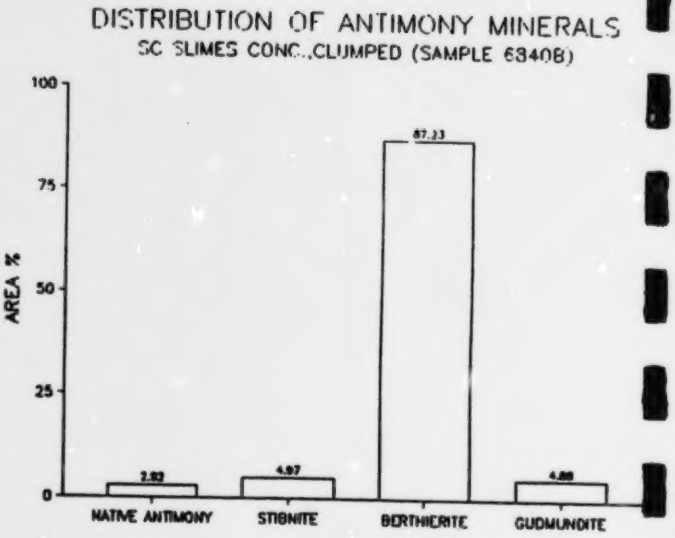

DISTRIBUTION OF ANTIMONY MINERALS
FINAL TAILINGS, +75 (SAMPLE 6841C)

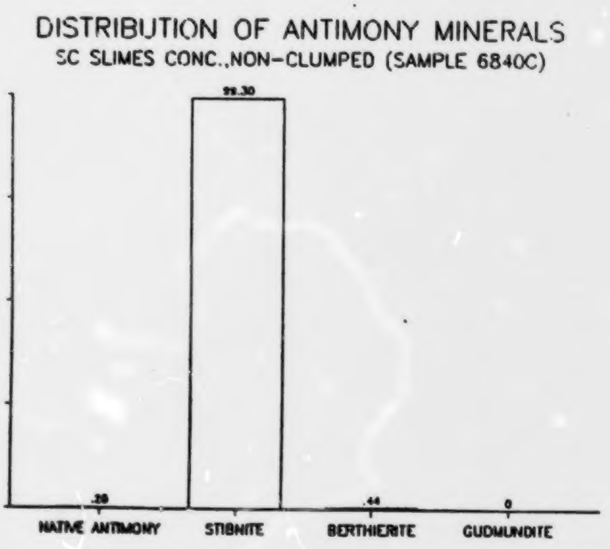
FIGURE A1.5



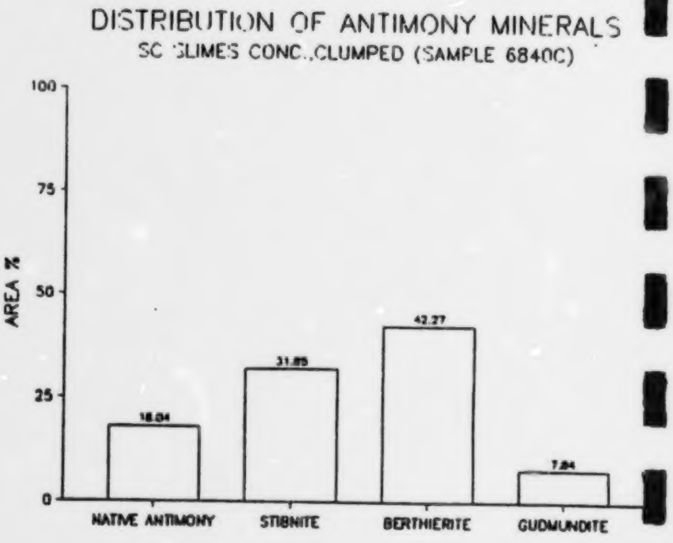
DISTRIBUTION OF ANTIMONY MINERALS
SC SLIMES CONC.,NON-CLUMPED (SAMPLE 6840B)



DISTRIBUTION OF ANTIMONY MINERALS
SC SLIMES CONC.,CLUMPED (SAMPLE 6840B)



DISTRIBUTION OF ANTIMONY MINERALS
SC SLIMES CONC.,NON-CLUMPED (SAMPLE 6840C)



DISTRIBUTION OF ANTIMONY MINERALS
SC SLIMES CONC.,CLUMPED (SAMPLE 6840C)

APPENDIX A-2

Calculations for the Mineral Distribution Data Based on Weighted Area

ABLE A2.1: AREA % AND WEIGHT % DISTRIBUTIONS FOR THE OK CONC. AND THE CLEANER CONC. SAMPLES. THE SPECIFIC GRAVITY VALUES USED FOR THE WEIGHT% DISTRIBUTIONS ARE AS FOLLOWS: NATIVE ANTIMONY 6.688, STIBNITE AND BERTHIERITE 4.65, AND GUDMUNDITE 6.13. SAMPLE CALCULATION FOR NATIVE ANTIMONY IN SAMPLE 6838A ARE AS FOLLOWS:

AREA% x S.G. = WEIGHTED AREA% (WTED AREA%)
2.40 x 6.688 = 16.05

(WTED AREA% . TOTAL WTED AREA%) x 100 = WEIGHT %
(16.05 . 470.02) x 100 = 3.41

	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)
AMPLE:	6838A			6838B			6838C		
ATIVE ANTIMONY	2.40	16.05	3.41	2.65	17.72	3.77	.97	6.49	1.39
TIBNITE	96.33	447.93	95.26	95.85	445.70	94.72	97.77	454.63	97.31
ERTHIERITE	1.09	5.06	1.08	1.39	6.45	1.37	1.15	5.34	1.14
UDMUNDITE	.19	1.16	.25	.11	.67	.14	.12	.74	.16
OTAL		470.21			470.55			467.19	
AMPLE:	6839A			6839B			6839C		
ATIVE ANTIMONY	2.37	15.85	3.37	1.17	7.82	1.67	.59	3.95	.85
TIBNITE	95.09	442.17	94.02	95.75	445.24	95.21	97.45	453.14	97.10
ERTHIERITE	2.20	10.21	2.17	2.89	13.41	2.87	1.86	8.63	1.85
UDMUNDITE	.34	2.08	.44	.19	1.16	.25	.09	.55	.12
OTAL		470.31			467.64			466.27	

TABLE A2.2: AREA % AND WEIGHT % DISTRIBUTIONS FOR THE SC SLIMES CONC. AND TAILINGS SAMPLES. THE SPECIFIC GRAVITY VALUES USED FOR THE WEIGHT% DISTRIBUTIONS ARE AS FOLLOWS: NATIVE ANTIMONY 6.688, STIBNITE AND BERTHIERITE 4.65, AND GUDMUNDITE 6.13. SAMPLE CALCULATION FOR NATIVE ANTIMONY IN SAMPLE 6840A ARE AS FOLLOWS:

AREA% x S.G. = WEIGHTED AREA% (WTED AREA%)
14.03 x 6.688 = 93.83

(WTED AREA% . TOTAL WTED AREA%) x 100 = WEIGHT %
(93.83 . 501.82) x 100 = 18.70

SAMPLE:	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)
	6840A			6840B			6840C		
NATIVE ANTIMONY	14.03	93.83	18.70	20.39	136.37	26.51	6.57	43.94	9.07
STIBNITE	12.11	56.31	11.22	10.67	49.62	9.64	62.91	292.53	60.38
BERTHIERITE	67.84	314.78	62.73	63.20	293.25	57.01	26.21	121.61	25.10
GUDMUNDITE	6.02	36.90	7.35	5.74	35.19	6.84	4.31	26.42	5.45
TOTAL		501.82			514.42			484.51	

SAMPLE:	6841A			6841B			6841C		
NATIVE ANTIMONY	.07	.47	.09	4.12	27.55	5.60	5.75	38.46	7.93
STIBNITE	19.45	90.44	18.31	5.58	25.95	5.28	62.87	292.35	60.26
BERTHIERITE	60.69	281.60	57.02	77.43	359.20	73.07	25.45	118.09	24.34
GUDMUNDITE	19.79	121.31	24.57	12.87	78.89	16.05	5.92	36.29	7.48
TOTAL		493.82			491.67			485.18	

TABLE A2.3: AREA % AND WEIGHT % DISTRIBUTIONS FOR THE CLUMPED AND NON-CLUMPED SC SLIMES CONC.. THE SPECIFIC GRAVITY VALUES USED FOR THE WEIGHT% DISTRIBUTIONS ARE AS FOLLOWS: NATIVE ANTIMONY 6.688, STIBNITE AND BERTHIERITE 4.65, AND GUDMUNDITE 6.13. SAMPLE CALCULATION FOR NATIVE ANTIMONY IN SAMPLE 6840B ARE AS FOLLOWS:

AREA% x S.G. = WEIGHTED AREA% (WTED AREA%)
0.12 x 6.688 = 1.74

(WTED AREA% . TOTAL WTED AREA%) x 100 = WEIGHT %
(1.74 . 465.53) x 100 = 0.37

	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)	AREA (in %)	WEIGHTED AREA %	WEIGHT % (normalized weighted area %)
SAMPLE:	6840B, NON-CLUMPED			6840B, CLUMPED			6840C, NON-CLUMPED		
NATIVE ANTIMONY	15.73	105.20	20.52	2.92	19.53	4.09	.26	1.74	.37
STIBNITE	9.90	46.04	8.98	4.97	23.11	4.84	99.3	461.75	99.19
BERTHIERITE	63.45	294.41	57.44	87.23	404.75	84.80	.44	2.04	.44
GUDMUNDITE	10.92	66.94	13.06	4.88	29.91	6.27	0	0	0
TOTAL		512.58			477.30			465.53	

SAMPLE:	6840C, CLUMPED		
NATIVE ANTIMONY	18.04	120.65	23.56
STIBNITE	31.65	147.17	28.74
BERTHIERITE	42.27	196.13	38.31
GUDMUNDITE	7.84	48.06	9.39
TOTAL		512.02	

APPENDIX A-3

Calculations for the Mineral Distribution Data Based on Frequency

TABLE A3.1: THE NUMBER OF GRAINS COUNTED IN THE MINERAL DISTRIBUTION STUDIES OF THE OK CONCENTRATE (6838A/B/C) AND CLEANER CONCENTRATE (6839A/B/C).

	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)
SAMPLE:	6838A		6838B		6838C	
NATIVE ANTIMONY	1220	2.00	1640	3.58	1010	4.01
STIBNITE	57900	95.15	41700	91.10	22200	88.06
BERTHIERITE	1350	2.22	2100	4.59	1630	6.47
GUDMUNDITE	384	.63	335	.73	369	1.46
TOTAL	60854		45775		25209	
# OF FRAMES	179		173		184	

SAMPLE:	6839A		6839B		6839C	
NATIVE ANTIMONY	516	1.33	1220	3.24	1070	3.30
STIBNITE	36200	93.07	33300	88.39	28400	87.50
BERTHIERITE	1700	4.37	2710	7.19	2460	7.58
GUDMUNDITE	480	1.23	442	1.17	527	1.62
TOTAL	38896		37672		32457	
# OF FRAMES	170		169		179	

TABLE A3.2: THE NUMBER OF GRAINS COUNTED IN THE MINERAL DISTRIBUTION STUDIES OF THE SC SLIMES CONC. (6840A/B/C) AND TAILINGS (6841A/B/C).

	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)
SAMPLE:	6840A		6840B		6840C	
NATIVE ANTIMONY	64	5.27	389	10.27	146	7.03
STIBNITE	214	17.63	694	18.32	625	30.11
BERTHIERITE	830	68.37	2260	59.65	919	44.27
GUDMUNDITE	106	8.73	446	11.77	386	18.59
TOTAL	1214		3789		2076	
# OF FRAMES	195		210		205	
SAMPLE:	6841A		6841B		6841C	
NATIVE ANTIMONY	3	.44	45	6.42	47	8.74
STIBNITE	105	15.33	95	13.55	114	21.19
BERTHIERITE	383	55.91	449	64.05	277	51.49
GUDMUNDITE	194	28.32	112	15.98	100	18.59
TOTAL	685		701		538	
# OF FRAMES	416		365		250	

TABLE A3.3: THE NUMBER OF GRAINS COUNTED IN THE MINERAL DISTRIBUTION STUDIES OF THE CLUMPED AND NON-CLUMPED MATERIAL IN THE SC. SLIMES CONC. (6840B/C).

	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)	COUNTS	DIST'N (in %)
SAMPLE:	6840B, NON-CLUMPED		6840B, CLUMPED		6840C, NON-CLUMPED	
NATIVE ANTIMONY	32	27.35	8	2.82	45	33.09
STIBNITE	16	13.68	13	4.58	49	36.03
BERTHIERITE	59	50.43	252	88.73	42	30.88
GUDMUNDITE	10	8.55	11	3.87	0	0
TOTAL	117		284		136	

SAMPLE:	6840C, CLUMPED	
NATIVE ANTIMONY	23	7.37
STIBNITE	52	16.67
BERTHIERITE	226	72.44
GUDMUNDITE	11	3.53
TOTAL	312	

APPENDIX A-4

Details of Liberation Examination of Antimony Phases

AS - average size (in sq. microns) based on the number of individual grains

counts - the number of whole particles containing the phase combination of interest

area - total surface area (in sq. microns) measured

Sc Slimes Concentrate, 6840A (-25 micron)

Grain Type	Liberation Class	Counts Area	Description
Berthierite	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	193 1431.4	-AS 7.42 sq. microns, # of individual grains: 193 -equant and semi-equant grains
Berthierite/ Native Sb	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	1 74.19	-72.25 sq. microns Native Sb(97.4%) -1.94 sq. microns Berthierite(2.6%) -AS Berthierite 0.65 sq. microns, 3 individual grains -large equant Native Sb and small acicular berthierite
	>95%	None	
Stibnite	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	46 313.57	-AS 6.82 sq. microns, # of individual grains: 46 -equant and semi-equant grains

5c Slimes Concentrate, 6840A (-25 micron) (Cont'd.)

Grain Type	Liberation Class	Counts Area	Description
Native Sb	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	10 190.24	-AS 19.02 sq. microns, # of individual grains: 10 -small equant and semi-equant grains
Gudmundite	<10%		
	10-25%		
	25-50%		
	50-75%		
	75-95%		
	>95%	10 173.53	-AS 17.35 sq. microns, # of individual grains: 10 -small equant and semi-equant grains

Sc Slimes Concentrate, 6840B (Non-Clumped, +25 micron)

Grain Type	Liberation Class	Counts	Area	Description
Berthierite	<10%	1	9.44	-AS 9.44 sq. microns, # of individual grains: 1 -tiny inclusion in gangue
	10-25%	2	366.56	-AS 45.82 sq. microns, # of individual grains: 9 -acicular berthierite in both particles
	25-50%	1	1737.8	-AS 347.56 sq. microns, # of individual grains: 5 -coarsely intergrown with gangue
	50-75%	3	470.72	-AS 94.14 sq. microns, # of individual grains: 5 -berthierite in all three particles coarsely intergrown with gangue
	75-95%	None		
	>95%	33	10771.28	-AS 326.40 sq. microns, # of individual grains: 33 -equant and semi-equant grains

Sc Slimes Concentrate, 6840B (Non-Clumped, +25 micron)

Grain Type	Liberation Class	Counts Area	Description
Berthierite/ Native Sb	>10%	None	
	10-25%	None	
	25-50%	1 440.56	-AS 44.06 sq. microns, # of individual grains: 10 -107 sq. microns berthierite (24.3%), 4 individual grains -333.56 sq. microns Native Sb (75.7%), 6 individual grains -acicular berthierite and blebby native Sb
	50-75%	None	
	75-95%	None	
	>95%	None	

Sc Slimes Concentrate, 6840B (Non-Clumped, +25 micron) (Cont'd.)

Grain Type	Liberation Class	Counts Area	Description
Berthierite/ Stibnite	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	1 720.67	-AS 102.95 sq. microns, # of individual grains: 7 -593.9 sq. microns berthierite (82.4%), 3 individual grains -126.77 sq. microns stibnite (17.6%), 4 individual grains -all equant and semi-equant grains
	>95%	None	
Stibnite	<10%	2 145.66	-AS 24.28 sq. microns, # of individual grains: 6 -both particles contain small equant sibnite grains.
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	6 1920.63	-AS 320.11 sq. microns, # of individual grains: 6 -equant and semi-equant grains

5c Slimes Concentrate, 6840B (Non-Clumped, +25 micron) (Cont'd.)

Grain Type	Liberation Class	Counts	Area	Description
Native Sb	<10%	2	39.57	-AS 19.79 sq. microns, # of individual grains: 2 -small blebs in both particles
	10-25%	2	147.93	-AS 29.59 sq. microns, # of individual grains: 5 -small blebby grains in both particles
	25-50%	4	548.49	-AS 60.94 sq. microns, # of individual grains: 9 -blebby grains in the particles
	50-75%	1	152.88	-AS 152.88 sq. microns, # of individual grains: 3 -large equant grains
	75-95%	1	538.6	-AS 538.6 sq. microns, # of individual grains: 1 -coarsely intergrown with gangue
	>95%	4	1633.7	-AS 408.43 sq. microns, # of individual grains: 4 -equant and semi-equant grains

3c Slimes Concentrate, 6840B (Non-Clumped, +25 micron) (Cont'd.)

Grain Type	Liberation Class	Counts Area	Description
Native Sb/ Gudmundite	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	1 688.32	-597.5 sq. microns Native Sb (86.8%), 1 individual grain -90.82 sq. microns gudmundite (13.2%), 2 individual grains -coarsely intergrown with gangue
	>95%	None	
Gudmundite	<10%	1 17.53	-AS 8.77 sq. microns, # of individual grains: 2 -small equant inclusions
	10-25%	None	
	25-50%	1 52.6	-AS 52.6 sq. microns, # of individual grains: 1 -coarsely intergrown with gangue
	50-75%	None	
	75-95%	None	
	>95%	5 1752.4	-AS 350.48 sq. microns, # of individual grains: 5 -equant and semi-equant grains

Sc Slimes Concentrate, 6840B (Clumped, +25 micron)

Grain Type	Liberation Class	Counts Area	Description
Berthierite	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	252 6238.03	-AS 24.75 sq. microns, # of individual grains: 252 -equant and semi-equant particles
Stibnite	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	13 355.18	-AS 27.32 sq. microns, # of individual grains: 13 -equant and semi-equant particles
Native Sb	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	8 208.6	-AS 26.08 sq. microns, # of individual grains: 8 -equant and semi-equant particles

Sc Slimes Concentrate, 6840B (Clumped, +25 micron) (Cont'd.)

Grain Type	Liberation Class	Counts Area	Description
Gudmundite	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	11 349.32	-AS 31.76 sq. microns, # of individual grains: 11 -equant and semi-equant particles

Sc Slimes Concentrate, 6840C (Non-Clumped, +75 micron)

Grain Type	Liberation Class	Counts Area	Description
Berthierite	<10%	1 92.17	-AS 13.17 sq. microns, # of individual grains: 7 -small equant to semi-equant inclusions in gangue
	10-25%	2 489.61	-AS 40.80 sq. microns, # of individual grains: 12 -acicular inclusions in one particle and a coarse intergrowth on the edge of the other particle
	25-50%	1 711.65	-AS 142.33 sq. microns, # of individual grains: 5 -grains clumped on edge of gangue only
	50-75%	None	
	75-95%	None	
	>95%	1 997.6	-AS 997.6 sq. microns, # of individual grains: 1 -equant and semi-equant particles
Berthierite/ Native Sb	<10%	None	
	10-25%	2 656.82	-AS 36.49 sq. microns, # of individual grains: 18 -1st grain: 171.74 sq. microns berthierite (35.3%), 6 individual grains

5c Slimes Concentrate, 6840C (Non-Clumped, +75 micron) (Cont'd.)

Grain Type	Liberation Class	Counts Area	Description
Berthierite/ Native Sb (cont'd)	10-25%		315.13 sq. microns native Sb (64.7%), 3 individual grains -2nd grain: 138.93 sq. microns berthierite (81.7%), 7 individual grains -31.02 sq. microns native Sb (18.3%) - 2 individual grains -blebby grains in one particle and acicular berthierite/blebby native Sb in the other
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	None	
Berthierite/ Stibnite	<10%	None	
	10-25%	1 793.48	-AS 113.35 sq. microns, # of individual grains: 7 -34.17 sq. microns berthierite (4.3%), 4 individual grains -759.31 sq. microns stibnite (95.7%), 3 individual grains -equant and semi-equant stibnite grains and acicular berthierite
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	None	

Sc Slimes Concentrate, 6840C (Non-Clumped, +75 micron) (Cont'd.)

Grain Type	Liberation Class	Counts	Area	Description
Stibnite	<10%	16	2858.78	-AS 95.29 sq. microns, # of individual grains: 30 -generally equant inclusions occurring on the edge only of about 1/3 of the gangue patticles
	10-25%	4	2755.12	-AS 344.39 sq. microns, # of individual grains: 8 -occurs as coarse, or acicular inclusions in gangue, occurring in one particle on the edge only
	25-50%	1	172.63	-AS 57.54 sq. microns, # of individual grains: 3 -coarsely intergrown
	50-75%	1	465.3	-AS 465.3 sq. microns, # of individual grains: 1 -equant and semi-equant particles
	75-95%	None		
	>95%	1	1049	-AS 1049 sq. microns, # of individual grains: 1 -equant and semi-equant particles

Sc Slimes Concentrate, 6840C (Non-Clumped, +75 micron) (Cont'd.)

Grain Type	Liberation Class	Counts	Area	Description
Stibnite/ Native Sb	<10%		None	
	25-50%		None	
	50-75%		None	
	75-95%		None	
	>95%	1	593834.5	-592808.54 sq. microns stibnite (99.8%), one massive grain -1025.96 sq. microns native Sb (0.2%), 43 individual grains (as -23.86 sq. microns) included in the massive stibnite
Native Sb	<10%	2	212.15	-AS 53.04 sq. microns, # of individual grains: 4 -small equant grains included in gangue
	10-25%		None	
	25-50%		None	
	50-75%		None	
	75-95%		None	
	>95%		None	

Sc Slimes Concentrate, 6840C (Clumped, +75 micron)

Grain Type	Liberation Class	Counts	Area	Description
Berthierite	<10%	1	2.7	-AS 2.7 sq. microns, # of individual grains: 1 -small equant grains in gangue
	10-25%	None		
	25-50%	None		
	50-75%	None		
	75-95%	None		
	>95%	213	5275.25	-AS 24.77 sq. microns, # of individual grains: 213 -small equant grains in gangue
Berthierite/ Native Sb	<10%	1	66.09	-45.86 sq. microns (69.4%), # of individual grains: 3 -20.23 sq. microns (30.6%), # of individual grains: 1 -small equant grains in gangue
	10-25%	1	148.36	-AS 44.06 sq. microns berthierite (29.7%), 3 individual grains -104.3 sq. microns native Sb (70.3%), 2 individual grains -equant and blebby berthierite and native Sb grains clumped together and included in gangue
	25-50%	None		
	50-75%	None		
	75-95%	None		
	>95%	None		

c Slimes Concentrate, 6840C (Clumped, +75 micron) (Cont'd.)

Grain Type	Liberation Class	Counts Area	Description
Berthierite/ Gudmundite	<10%	2 72.39	-AS 14.48 sq. microns, # of individual grains: 5 -grain #1: 27.43 sq. microns berthierite (50.8%), 2 individual grains -26.52 sq. microns gudmundite (49.2%), 1 individual grain -grain #2: 4.5 sq. microns (24.4%), 1 grain -13.94 sq. microns (75.6%), 1 grain -equant and semi-equant grains intergrown with gangue
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	None	
Stibnite	<10%	2 333.14	-AS 55.52 sq. microns, # of individual grains: 6 -small equant inclusions in gangue
	10-25%	None	
	25-50%	1 561.5	-AS 561.5 sq. microns, # of individual grains: 1 -coarsely intergrown with gangue

Sc Slimes Concentrate, 6840C (Clumped, +75 micron) (Cont'd.)

Grain Type	Liberation Class	Counts Area	Description
Stibnite (Cont'd.)	50-75%	None	
	75-95%	None	
	>95%	43 3221.12	-AS 74.91 sq. microns, # of individual grains: 43 -equant and semi-equant particles
Native Sb	<10%	None	
	10-25%	None	
	25-50%	1 247.3	-AS 247.3 sq. microns, # of individual grains: 1 -blebby grain included in gangue
	50-75%	None	
	75-95%	1 339	-AS 339 sq. microns, # of individual grains: 1 -coarse intergrowth with gangue
	>95%	18 1652.58	-AS 91.81 sq. microns, # of individual grains: 18 -equant particles
Gudmundite	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	9 987.19	-AS 109.69 sq. microns, # of individual grains: 9 -equant and semi-equant particles

Final Tailings, 6841A (-25 micron)

Grain Type	Liberation Class	Counts	Area	Description
Berthierite	<10%	2	3.20	-AS 1.6 sq. microns, # of individual grains: 2 -small equant inclusions in gangue
	10-25%	1	3.36	-AS 3.36 sq. microns, # of individual grains: 1 -small equant inclusions in gangue
	25-50%	None		
	50-75%	None		
	75-95%	None		
	>95%	118	1753.3	-AS 14.86 sq. microns, # of individual grains: 118 -equant and semi-equant particles
Stibnite	<10%	None		
	10-25%	None		
	25-50%	None		
	50-75%	None		
	75-95%	None		
	>95%	18	294.19	-AS 16.34 sq. microns, # of individual grains: 18 -equant and semi-equant particles

inal Tailings, 6841A (-25 micron) (Cont'd)

Grain Type	Liberation Class	Counts	Area	Description
Native Sb	<10%	None		
	10-25%	None		
	25-50%	None		
	50-75%	None		
	75-95%	None		
	>95%	1	2.89	-AS 2.89 sq. microns, # of individual grains: 1 -equant and semi-equant particles
Gudmundite	<10%	None		
	10-25%	None		
	25-50%	None		
	50-75%	None		
	75-95%	1	55.43	-AS 55.43 sq. microns, # of individual grains: 1 -coarsely intergrown with gangue
	>95%	18	285.29	-AS 15.85 sq. microns, # of individual grains: 18 -equant and semi-equant particles

Final Tailings, 6841B (+25 microns)

Grain Type	Liberation Class	Counts	Area	Description
Berthierite	<10%	13	214.01	-AS 11.89 sq. microns, # of individual grains: 18 -generally small equant to semi-equant inclusions with one occurrence of acicular grains and two occurrences on the edge
	10-25%	9	406.70	-AS 31.28 sq. microns, # of individual grains: 13 -generally small equant to semi-equant inclusions with three instances of fine acicular inclusions in the gangue
	25-50%	6	1053.23	-AS 37.62 sq. microns, # of individual grains: 28 -generally fine to coarse equant inclusions with one occurrence of acicular inclusions in the gangue
	50-75%	6	2635.88	-AS 292.88 sq. microns, # of individual grains: 9 -generally massive intergrowths with one occurrence on the edge of the gangue only
	75-95%	3	695.87	-AS 231.96 sq. microns, # of individual grains: 3 -coarsely intergrown

Final Tailings, 6841B (+25 microns)

Grain Type	Liberation Class	Counts	Area	Description
Berthierite (cont'd)	>95%	13	6087.29	-AS 468.25 sq. microns, # of individual grains: 13 -generally massive with 3 occurrences of small (<3%) gangue inclusions within the berthierite
Berthierite/ Native Sb	<10%	None		
	10-25%	None		
	25-50%	None		
	50-75%	None		
	75-95%	None		
	>95%	1	1452.95	-AS 1452.95 sq. microns, 1448 sq. microns berthierite (99.7%) 4.95 sq. microns native Sb (0.3%) -small inclusion of native antimony and quartz in massive berthierite
Stibnite	<10%	11	128.59	-AS 9.89 sq. microns, # of individual grains: 13 -generally small equant inclusions with two occurrences on the edge of the gangue only and 2 occurrances of fine acicular inclusions
	10-25%	None		

Final Tailings, 6841B (+25 microns)

Grain Type	Liberation Class	Counts Area	Description
Stibnite (cont'd)	25-50%	1 63.85	-AS 21.28 sq. microns, # of individual grains: 3 -small equant inclusions
	50-75%	None	
	75-95%	None	
	>95%	1 674.80	-AS 647.80 sq. microns, # of individual grains: 1 -small (<2%) gangue inclusions within the massive stibnite
Native Sb	<10%	1 2.25	-AS 2.25 sq. microns, # of individual grains: 1 -small blebby inclusion in gangue
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	1 652.3	-AS 652.3 sq. microns, # of individual grains: 1 -massive inclusion-free

inal Tailings, 6841B (+25 microns)

Grain Type	Liberation Class	Counts	Area	Description
Gudmundite	<10%	None		
	10-25%	1	3.60	-AS 3.60 sq. microns, # of individual grains: 1
	25-50%	1	627.59	-AS 209.20 sq. microns, # of individual grains: 3 -coarsely intergrown with gangue
	50-75%	None		
	75-95%	1	1605.00	-AS 1605 sq. microns, # of individual grains: 1 -coarsely intergrown with gangue
	>95%	6	7737.99	-AS 1289.67 sq. microns, # of individual grains: 6 -massive with 2 occurrences of small (<3%) gangue inclusions

nal Tailings, 6841C (+75 microns)

Grain Type	Liberation Class	Counts	Area	Description
Berthierite	<10%	8	1182.02	-AS 59.10 sq. microns, # of individual grains: 20 -generally equant inclusions, with two occurrences on the edge of acicular inclusions and one occurrence on the edge of gangue only
	10-25%	6	7497.16	-AS 288.35 sq. microns, # of individual grains: 26 -either coarse intergrowths or acicular inclusions
	25-50%	3	3112.52	-AS 389.07 sq. microns, # of individual grains: 8 -coarse intergrowths, one occurring on the edge only
	50-75%	1	1054.60	-AS 527.30 sq. microns, # of individual grains: 2 -coarsely intergrown with gangue
	75-95%	1	997.3	-AS 997.3 sq. microns, # of individual grains: 1 -coarsely intergrown with gangue
	>95%	4	17108	-AS 4277 sq. microns, # of individual grains: 4 -equant and semi-equant particles

Final Tailings, 6841C (+75 microns) (Cont'd.)

Grain Type	Liberation Class	Counts Area	Description
Stibnite	<10%	32 1983.53	-AS 36.73 sq. microns, # of individual grains: 54 -generally small equant inclusions with 6 occurrences on the edge only and 2 occurrences of acicular inclusions
	10-25%	5 2472.89	-AS 82.43 sq. microns, # of individual grains: 30 -generally acicular inclusions with one occurrence of coarse intergrowths
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	6 23885.62	-AS 3980.94 sq. microns, # of individual grains: 6 -equant and semi-equant particles
Stibnite/	<10%	None	
	10-25%	None	
	25-50%	None	
	50-75%	None	
	75-95%	None	
	>95%	1 8041.4	-AS 8041.4 sq. microns stibnite (99.6%) 31.40 sq. microns native Sb (0.4%) -massive stibnite with small native Sb inclusions

inal Tailings, 6841C (+75 microns) (Cont'd.)

Grain Type	Liberation Class	Counts	Area	Description
Native Sb	<10%	1	20.32	-AS 20.32 sq. microns, # of individual grains: 1 -small blebby inclusion in gangue
	10-25%	None		
	25-50%	None		
	50-75%	None		
	75-95%	None		
	>95%	1	3872.58	-AS 3872.58 sq. microns, # of individual grains: 1 -equant and semi-equant particles

APPENDIX B

MINERAL RESOURCES BRANCH, D.N.R.E.

PROCESS STUDIES REPORT

DATE	PREPARED BY	CONSIGNEE
30 Sept 1987	R. D. Harris	Durham Resources Inc.

PROJECT	PROJECT NUMBER
Flash Flotation Study - MISP Project 8610-21G14	-

TASK	REFERENCE NUMBER
Mass Balance of Circuit Using MatBal	-

OBJECTIVE / RESULTS / DISCUSSION

1.0 OBJECTIVE: To assess the effectiveness of the flash flotation cell as part of the grinding circuit and to determine its effect on the overall performance (recovery) of the concentrator.

2.0 RESULTS: Mass balance results, see attached Printout No. 1

3.0 DISCUSSION:

3.1 The mass balance was conducted on the flowsheet configuration shown in Figure 1. MatBal, a computer program developed by CANMET for doing mass balance type calculations, was used to carry out the balance. Using the measured assays and mill feed tonnage given in Table 1, the program calculated a flow tonnage of each stream represented by a number on the flowsheet.

3.2 Although assays were also available around the grinding and classification circuit, these were not entered into the calculations because of the common problem of not being able to obtain representative samples around these operations, which traditionally has led to significant errors. Preliminary runs have suggested that there are indeed problems (errors) with the data around these specific operations.

3.3 Printout No. 1 shows the results of the mass balance calculations. These results were based on the input data indicated by Printout No. 2, which essentially consist of the data given in Figure 1 (mass balance equations) and Table 2 (assays and mill feed tonnage). The measured mill feed tonnage was assigned on accurracy of 0.0001%, while the assay values were assigned a 5% error deviation. It should be pointed out that, since MatBal is an iterative-type program based on a convergence principle, the maximum allowable deviation in the flowrates between iterations was set at 0.1% as was the deviation in calculating assay adjustments. This is a fairly tight convergence criteria which the program achieved quite easily with the data used.

3.4 According to the results of the mass balance (Printout 1) approximately 0.788 MT/Hour of concentrate assaying 63.4% was produced, of which 45% of the concentrate (tonnage) was from the OK flash flotation cell. This translates into a recovery figure of about 38% around the flash cell relative to the mill feed stream.

An interesting observation is the particle size distribution of the OK cell concentrate. The distribution data are given in Table 2. The reason for the application of the cell in this configuration (i.e., within the grinding circuit) was to try and float coarse (+75) liberated stibnite in effort to prevent slime loss due to over grinding. However, the data indicate that the majority (50%) of the flotation concentrate is made up of fine -25um material. This phenomenon may suggest that:

A. a majority of the coarse (+75um) material is not liberated, thereby preventing flotation of this size fraction.

B. the flotation of alot of fine stibnite, proportionally, indicates the fine-grained nature of the mineral (stibnite) association and its amenability to flotation considering the relatively short retention time of the cell.

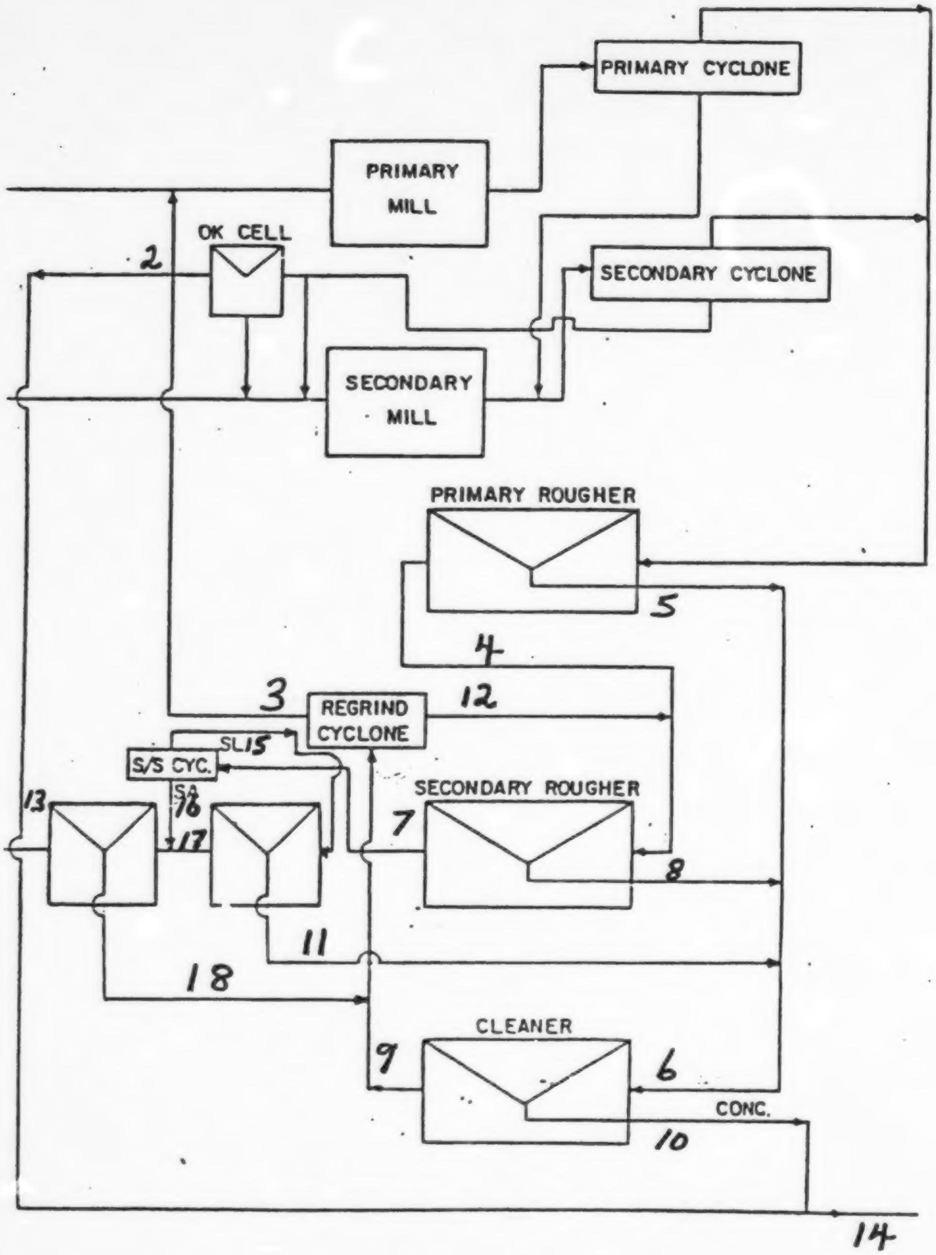


FIGURE 1

Durham's Flowsheet Including Flash Flotation Cell

TABLE 1

Assays of Antimony Corresponding to the Streams Indicated in Figure 1

Stream No.	Stream Name	% Antimony
1.	Mill Feed	3.6
2.	OK Cell Conc.	61.6
3.	R. Cyclone Underflow	7.54
4.	P. Rougher Tail	1.16
5.	P. Rougher Conc.	30.80
6.	Cleaner Feed	20.60
7.	S. Rougher Tail	1.19
8.	S. Rougher Conc.	13.20
9.	Cleaner Tail	4.84
10.	Cleaner Conc.	64.20
11.	Scav. Slimes Conc.	5.90
12.	R. Cyclone Overflow	4.23
13.	Final Tail	0.56
14.	Final Conc.	69.40
15.	Scav. Slimes Feed	1.82
16.	Scav. Sands Feed	1.06
17.	Scav. Slimes Tail	1.04
18.	Scav. Sands Conc.	7.26

Measured Flowrate - Mill Feed: 16.32 MT/H

TABLE 2

Distribution of Size Fractions in the OK Cell Concentrate

Size Fraction	Weight Distribution (%)	Assay (%Sb)	% Sb Distr.
+75	13.5	67.7	15.0
-75 +25	32.5	66.4	35.3
-25	54.0	56.0	49.7
	100.0		100.0

```
 M    STREAM                 OBSERVED  CALCULATED   WT.PCT.
 1    MILL FEED               16.3200     16.3200   100.0000
 2    OK CELL CONC              N-O         .3610     2.2120
 3    R.CYCLONE UNDERFLOW       N-O        1.3461     8.2483
 4    P.ROUGHER TAIL            N-O       16.4134   100.5724
 5    P.ROUGHER CONC.           N-O         .8917     5.4639
 6    CLEANER FEED              N-O        1.6201     9.9269
 7    S.ROUGHER TAIL            N-O       17.2640   105.7841
 8    S.ROUGHER CONC            N-O         .2300     1.4092
 9    CLEANER TAIL              N-O        1.1928     7.3085
10    CLEANER CONC              N-O         .4273     2.6184
11    SCAV SLIMES CONC          N-O         .4984     3.0538
12    R.CYCLONE OVERFLOW        N-O        1.0805     6.6209
13    FINAL TAIL                N-O       15.5317    95.1696
14    FINAL CONC                N-O         .7883     4.8304
15    SCAV SLIMES FEED          N-O        5.0370    30.8640
16    SCAV SANDS FEED           N-O       12.2270    74.9201
17    SCAV SLIMES TAIL          N-O        4.5386    27.8102
18    SCAV SANDS CONC           N-O        1.2339     7.5607

\NALYSES

\NTIMONY ASSAY
 M   STREAM                 OBSERVED  CALCULATED   RECOVERY      WT UNITS
 1   MILL FEED                3.6000     3.5985     100.00       .58727
 2   OK CELL CONC            61.6000    62.0022      38.114      .22383
 3   R.CYCLONE UNDERFLOW      7.5400     7.5429      17.290      .10154
 4   P.ROUGHER TAIL           1.1600     1.1609      32.446      .19054
 5   P.ROUGHER CONC          30.8000    30.7763      46.730      .27443
 6   CLEANER FEED            20.6000    20.6272      56.903      .33418
 7   S.ROUGHER TAIL           1.1900     1.1927      35.063      .20592
 8   S.ROUGHER CONC          13.2000    13.1972      5.1682      .30352E-01
 9   CLEANER TAIL             4.8400     4.8386      9.8273      .57713E-01
:0   CLEANER CONC            64.2000    64.6973      47.076      .27646
:1   SCAV SLIMES CONC         5.9000     5.8970      5.0044      .29389E-01
12   R.CYCLONE OVERFLOW       4.2300     4.2315      7.7857      .45723E-01
.3   FINAL TAIL                .5600      .5600      14.811      .86979E-01
:4   FINAL CONC              64.4000    63.4631      85.189      .50029
.5   SCAV SLIMES FEED         1.5200     1.5199      13.036      .76559E-01
:6   SCAV SANDS FEED          1.0600     1.0580      22.027      .12936
 7   SCAV SLIMES TAIL         1.0400     1.0393      8.0320      .47170E-01
:8   SCAV SANDS CONC          7.2600     7.2572      15.248      .89547E-01

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ANALYSIS OF ASSAY ADJUSTMENTS

NODE IMBALANCE CALCULATED WITH OBSERVED ASSAYS AND CALCULATED WEIGHTS

NORMAL NODES
 N    O=       1
 1            .2
 2            .1
 3            .2
 4            .0
 5            .0
 6            .0
 7           -.1
 8            .0
 9          -1.1


SPECIAL NODES,(0.0 WHEN BNNO=0.).
NN    O=       1
 1            .0


STANDARD ANALYSIS RESIDUALS
 M    O=       1
 1            .0
 2           -.1
 3            .0
 4            .0
 5            .0
 6            .0
 7            .0
 8            .0
 9            .0
10           -.2
11            .0
12            .0
13            .0
[illegible]
```

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AVERAGE S.S. OF STANDARD RESIDUALS PER STREAM
 M STREAM (M)                   STD.RES.
 1 MILL FEED                       .0001
 2 OK CELL CONC                    .0171
 3 R.CYCLONE UNDERFLOW             .0001
 4 P.ROUGHER TAIL                  .0002
 5 P.ROUGHER CONC                  .0002
 6 CLEANER FEED                    .0007
 7 S.ROUGHER TAIL                  .0021
 8 S.ROUGHER CONC                  .0000
 9 CLEANER TAIL                    .0000
10 CLEANER CONC                    .0240
11 SCAV SLIMES CONC                .0001
12 R.CYCLONE OVERFLOW              .0001
13 FINAL TAIL                      .0000
14 FINAL CONC                      .0847
15 SCAV SLIMES FEED                .0000
16 SCAV SANDS FEED                 .0015
17 SCAV SLIMES TAIL                .0002
18 SCAV SANDS CONC                 .0001

AVERAGE S.S. OF STANDARD RESIDUALS PER ANALYSIS TYPE.
 M STREAM (M)                   STD.RES.
 1 ANTIMONY ASSAY                  .0073

OVERALL S.S. OF STANDARD ANALYSIS RESIDUALS=            .13108

STANDARDIZED STREAM WEIGHTS RESIDUALS
 M STREAM (M)                   STD.RES.
 1 MILL FEED                     -.1169
 2 OK CELL CONC                   N-A
 3 R.CYCLONE UNDERFLOW            N-A
 4 P.ROUGHER TAIL                 N-A
 5 P.ROUGHER CONC                 N-A
 6 CLEANER FEED                   N-A
 7 S.ROUGHER TAIL                 N-A
 8 S.ROUGHER CONC                 N-A
 9 CLEANER TAIL                   N-A
10 CLEANER CONC                   N-A
11 SCAV SLIMES CONC               N-A
12 R.CYCLONE OVERFLOW             N-A
13 FINAL TAIL                     N-A
14 FINAL CONC                     N-A
15 SCAV SLIMES FEED               N-A
16 SCAV SANDS FEED                N-A
```

```
Not ready error reading drive A
Abort, Retry, Ignore? R

Stop - Program terminated.

C:\FORTRAN>REM

C:\FORTRAN>REM

C:\FORTRAN>REM     *********** TERMINATING MATBAL4B PROC ******************

C:\FORTRAN>
C:\FORTRAN>CD\
)3,R.CYCLONE UNDERFLOW
)4,P.ROUGHER TAIL
)5,P.ROUGHER CONC
)6,CLEANER FEED
)7,S.ROUGHER TAIL
)8,S.ROUGHER CONC
)9,CLEANER TAIL
10,CLEANER CONC
11,SCAV SLIMES CONC
12,R.CYCLONE OVERFLOW
13,FINAL TAIL
14,FINAL CONC
15,SCAV SLIMES FEED
16,SCAV SANDS FEED
17,SCAV SLIMES TAIL
18,SCAV SANDS CONC
)1,3.6
)2,61.6
)3,7.54
)4,1.16
)5,30.8
)6,20.6
)7,1.19
)8,13.2
)9,4.84
:0,64.2
:1,5.9
:2,4.23
:3,0.56
:4,64.4
:5,1.52
:6,1.06
:7,1.04
.8,7.26
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)6,3,15,-11,-17
)7,3,7,-16,-15
)8,4,16,17,-13,-18
)9,3,2,10,-14
:1,16.32,0.0001
.1
```